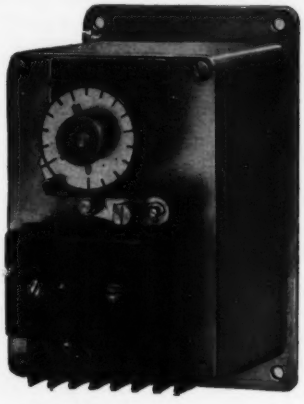
Vol. 15 No. 2 February 1961 Published Monthly

INSTRUMENT PRACTICE

Physics

CONTROL SYSTEMS - ELECTRONICS - AUTOMATION



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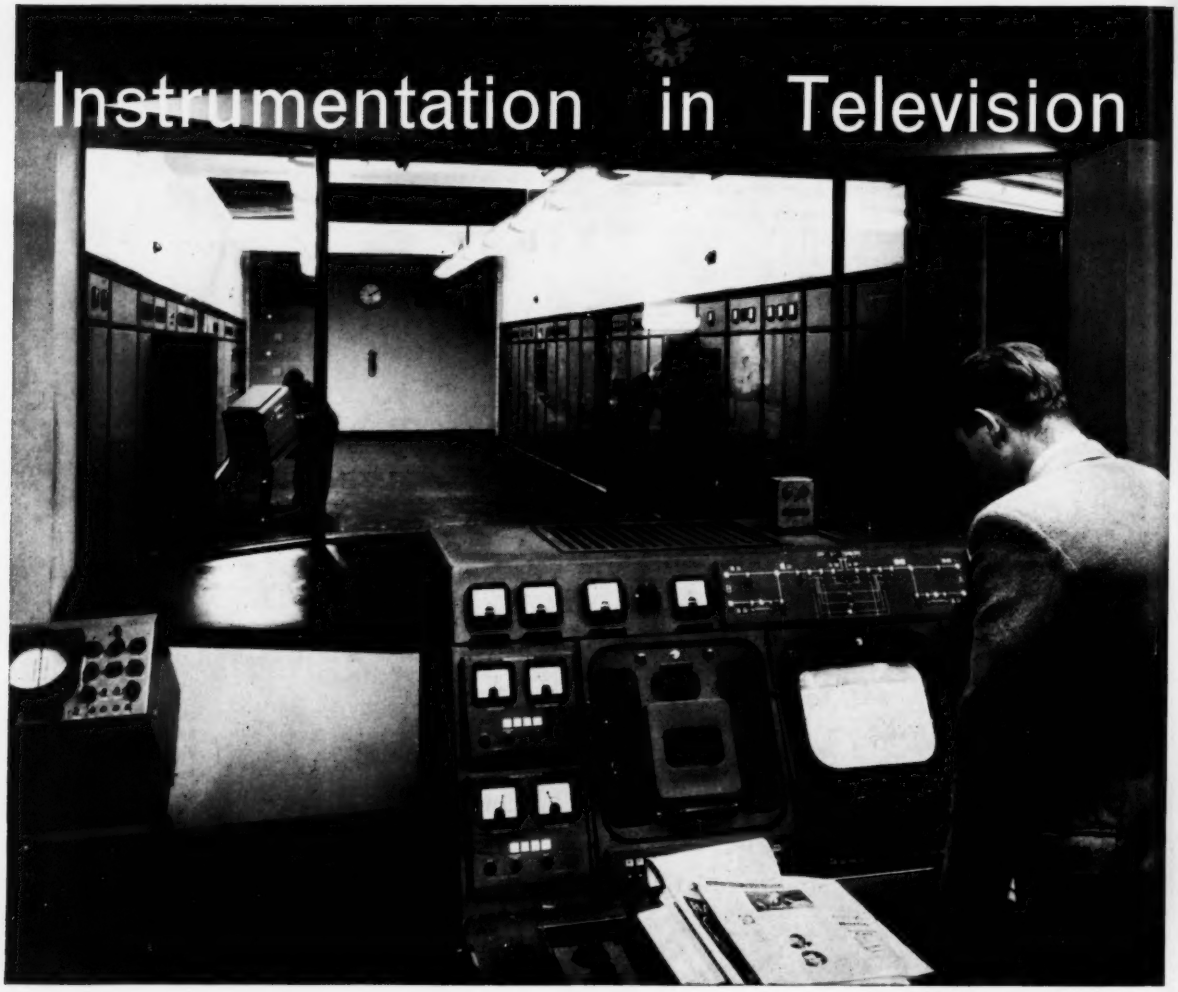
Instrumentation in Television



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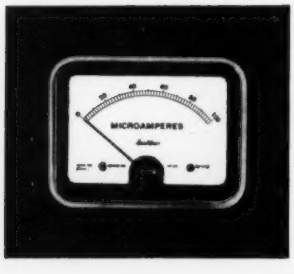

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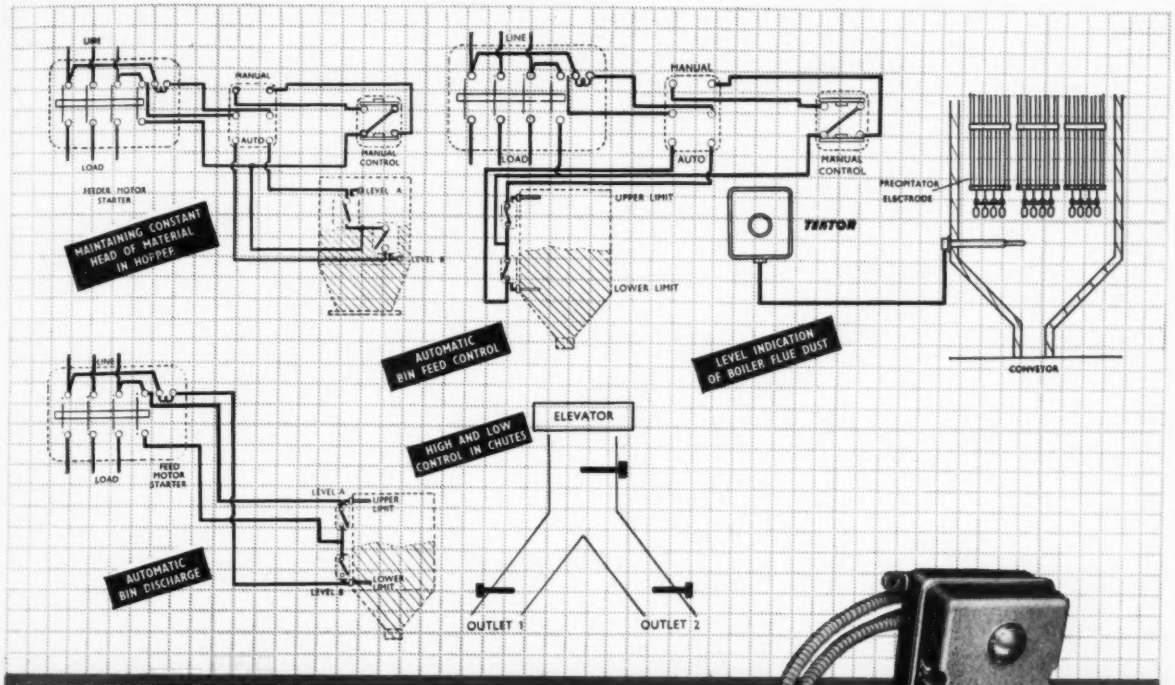
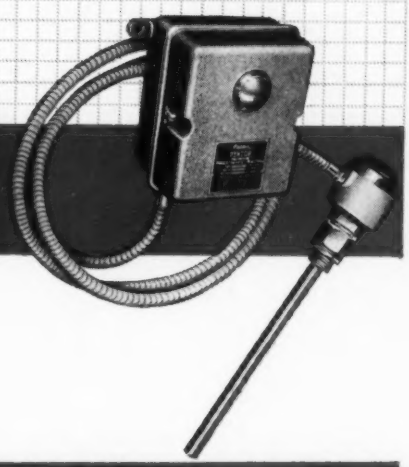
level control and indication



by the Fielden CAPACITANCE METHOD



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- Simple to install.
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- Up to 250 feet of cable length between controller and sensing electrode.
- No moving parts in the container.
- Over 100,000 installed throughout the world.

The range includes the famous

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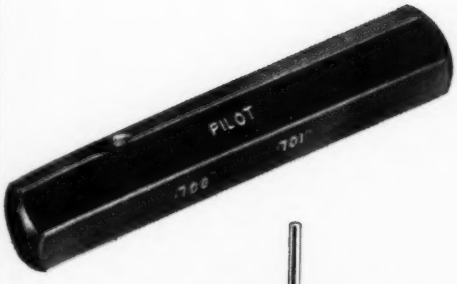

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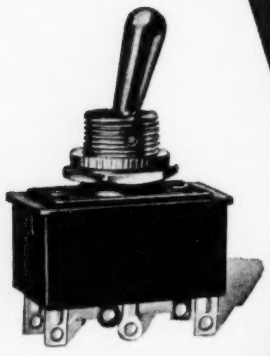
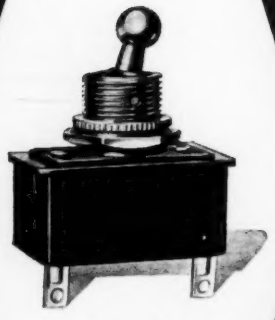
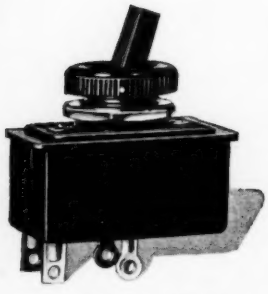


* Cat. No. 81058-BT Double Pole Double Throw 2 Position Lever Type Back Connecting Lugs



Cat. No. 81046 Single Pole Single Throw. 2 Position Lever Type. Back Connecting Lugs



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The exacting conditions of service demanded by modern techniques in electronic equipment and instrument development are fully matched by this new range of ARROW bakelite enclosed switches.

Their main characteristic is the maintenance of low contact resistance after considerable life.

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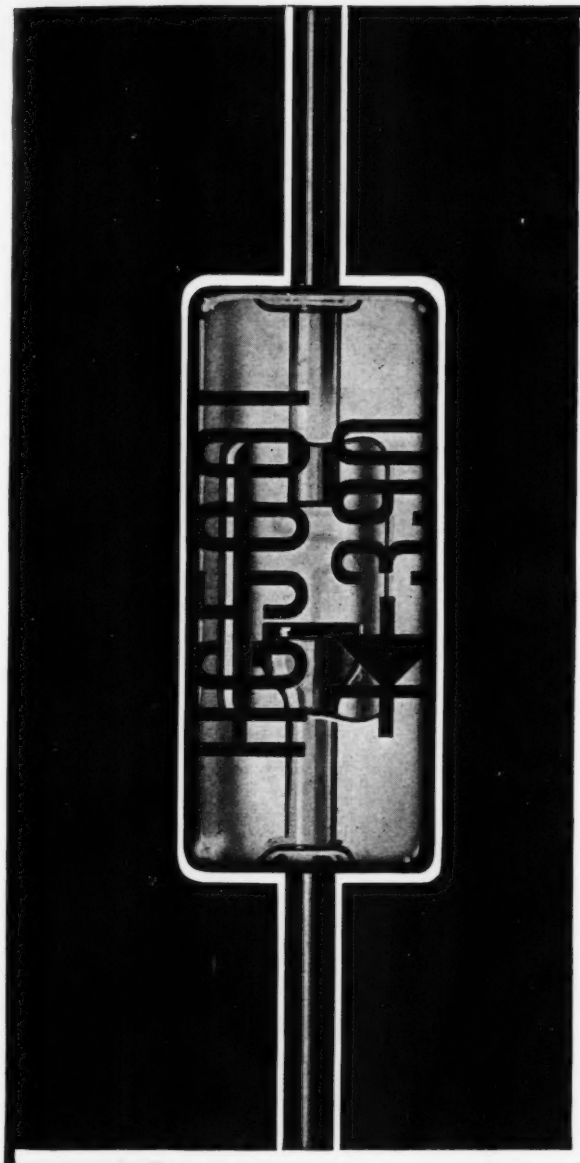

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Actual size

Type No.	Continuous ratings 25°C		Characteristics 25°C	
	Max. Reverse Volts	Max. Forward Current	Max. Volts Drop	Max. Reverse Current
HG5001	100	80 mA	.8 v @ 100mA	5μA @—50V
HG5002	70	80 mA	.8 v @ 100mA	5μA @—50V
HG5003	100	80 mA	.8 v @ 100mA	25μA @—50V
HG5004	70	80 mA	.8 v @ 100mA	25μA @—50V
HG5005	100	80 mA	.8 v @ 100mA	50μA @—50V
HG5006	70	80 mA	.8 v @ 100mA	50μA @—50V
HG5007	40	80 mA	.8 v @ 100mA	5μA @—30V
HG5008	40	80 mA	.8 v @ 100mA	25μA @—30V
HG5009	40	80 mA	.8 v @ 100mA	50μA @—30V

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OMT ROUNDNESS MEASURING MACHINE

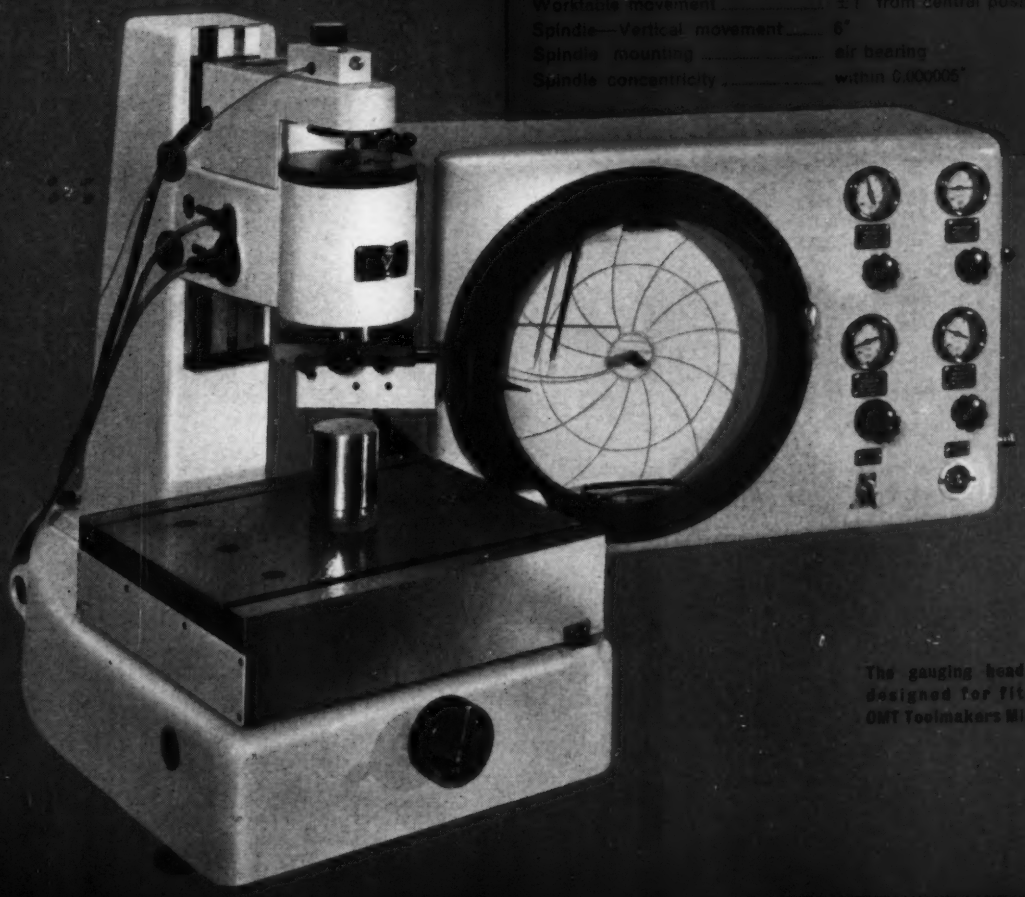
Features
Determines roundness errors within 0.00001"
Compactly designed with few controls
Wide measuring range
Recordings magnified 1,000x or 5,000x
Large record chart facilitates checking

Ask for publication 140/60

a moderately-priced instrument for general workshop or standards room employmen

Abridged specification

Measuring range — external	$\frac{1}{2}$" to 6" diameter
— internal	$\frac{1}{2}$" to 6" diameter
Worktable area	12" x 10"
Worktable movement	± 1" from central position
Spindle — Vertical movement	6"
Spindle mounting	air bearing
Spindle concentricity	within 0.000005"



The gauging head is also designed for fitment to OMT Toolmakers Microscope

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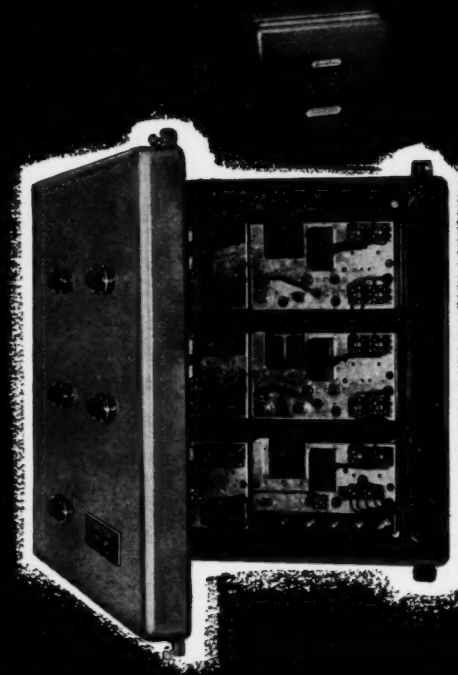


The LEVELTRON Console

A MULTIPOINT AUTOMATIC CONTROLLER

A specially designed automatic bin controller has been developed to cover the automatic filling and emptying of bins, tanks and silos. This automatic controller is designed to cover up to six bins, giving control of motorised or solenoid operated valves for filling and emptying, controlling feed conveyors and elevators, etc., in sequence.

A team of highly skilled industrial electronic engineers manufacture and assemble this important automatic level controller. Only the finest components and materials available are used.

Simplicity of design and surface wiring enables easy maintenance.

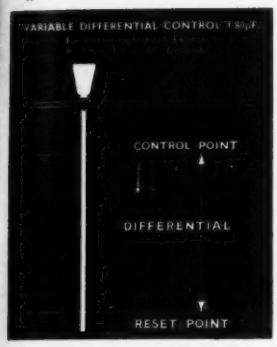
A weatherproof, dustproof console houses the famous Leveltron industrial controllers together with all ancillary equipment. A neatly designed indicating panel is incorporated giving easy visual indication.

The centralisation of level control and indication has simplified the use of this equipment on plant and has also saved considerably on installation costs. Already the use of this new automatic bin controller has increased efficiency in production and has saved considerable man hours. *Patents Pending*

Circle 65 for further information

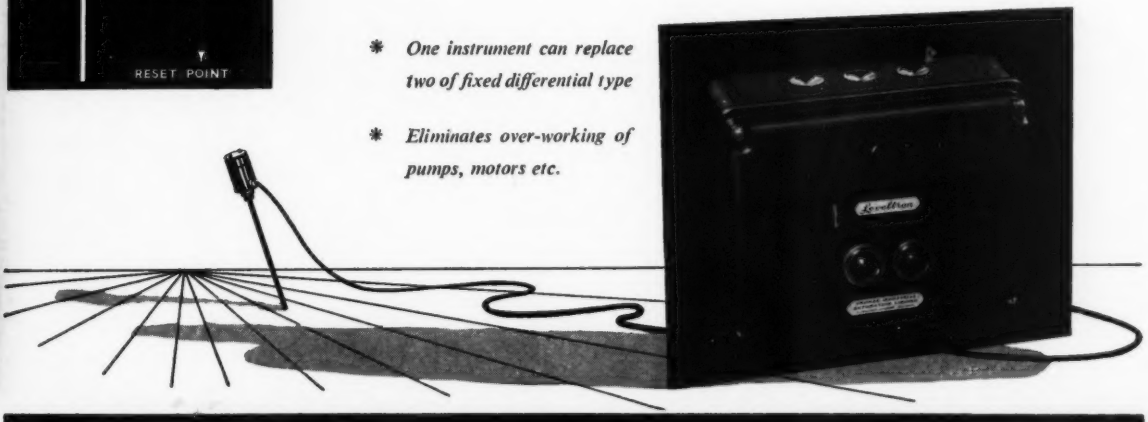
The LEVELTRON REGD.

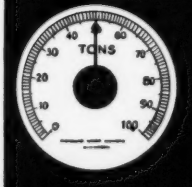
for CENTRALISED LEVEL CONTROL



Sets new standard of sensitivity, stability and reliability in level detection of flour, meals, grain, wheat etc., and all liquids. Stability within 0.5 pf. maintained over long periods. Special Duty Electrode systems eliminate worries of 'build-up.' Can detect level changes with remote electrode systems up to 500 feet from controller with *no electronics in electrode head or on container*. Standard cable lengths up to 35 feet. Specially designed dust and weatherproof cast iron case. 'Fail to Safe' high or low level on standard instruments.

* *One instrument can replace two of fixed differential type*
* *Eliminates over-working of pumps, motors etc.*





The LEVOLOG REGD.

CONTINUOUS LEVEL INDICATOR

This capacitance operated instrument is used with a vertically mounted Electrode system in containers of all types up to 60 ft. in depth. Can be used with flour, powders, free-flowing solids and liquids. Local indication provided, remote indication any distance from controller. *Sets new standard in continuous level indication.* Independent of mains and temperature variations. Near linear scales which are calibrated to customers' requirements. Control unit housed in dust and weather-proof Cast Iron Case.

MULTIPOINT UNIT from 5 to 50 points for centralisation.

SIMPLE to operate. SIMPLE to instal. Write for details.

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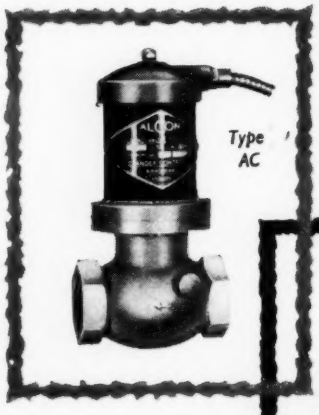
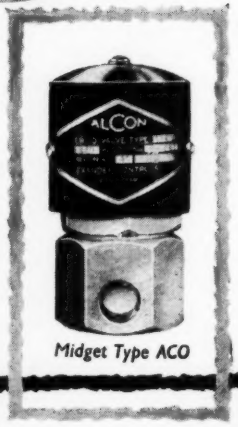
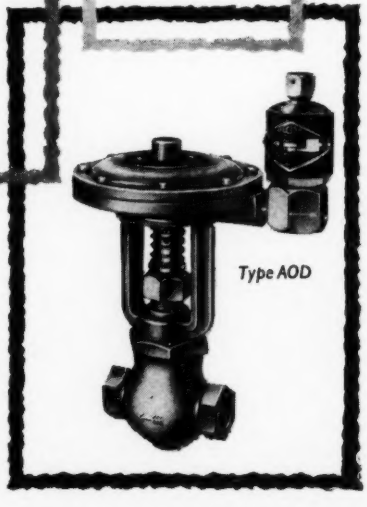
TYPE AC. Normally closed, opens when electrically energised. Sizes from $1\frac{1}{2}$ in. to 3 in. bore to control gas, air, oil, etc.

TYPE ACP. Servo Operated Piston Type. Will handle liquids and gases at high pressure with a small expenditure of electrical power.

TYPE AOD. Heavy duty air operated units, individually designed for control applications beyond capabilities of Solenoid types. For pressures up to 1,500 p.s.i. Sizes $\frac{1}{4}$ in. B.S.P. - 8 in. bore.







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Thermocouple alloys 'done by' British Driver-Harris 'do' sterling work in all sorts of industrial temperature measuring applications. The range of alloys including T1* and T2* (the only British-made base metal thermocouple for use up to 1100°C) is suitably all-embracing.

Something you can only find out by actually putting us to the test is what *we* mean by that much overworked word, "service". If you are in the market, in however small a way, for thermocouple wire or strip, it would almost certainly pay you to find out.

T1 and T2** are wires of the nickel-chromium/nickel-aluminium type for use at high temperatures and conform to the British Standard Specification 1827:1952 within the usual tolerances. They also meet the requirements laid down in Air Ministry Specifications 1632 and 1705 covering extensions leads. *Special Advance** wire (60/40 copper-nickel) is for use with copper up to 400°C and with iron up to 900°C. The EMF requirements of these two combinations vary according to individual specifications. Special Advance* wires can be selected in most cases to meet these varying demands within the usual tolerances.

Matched Advance Iron Wires* The non-availability of a Standard Iron and the variation of EMF properties experienced with different iron supplies result in some difficulty in reproducing thermocouple EMF properties. To overcome this difficulty we are now able to provide a Special Iron wire matched with Special Advance* to meet certain standard EMF requirements within the normal tolerances.

**Registered Trade Mark*

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If you are interested in thermocouple alloys, then you may like to have a copy of Data Sheet No. 2 for reference.

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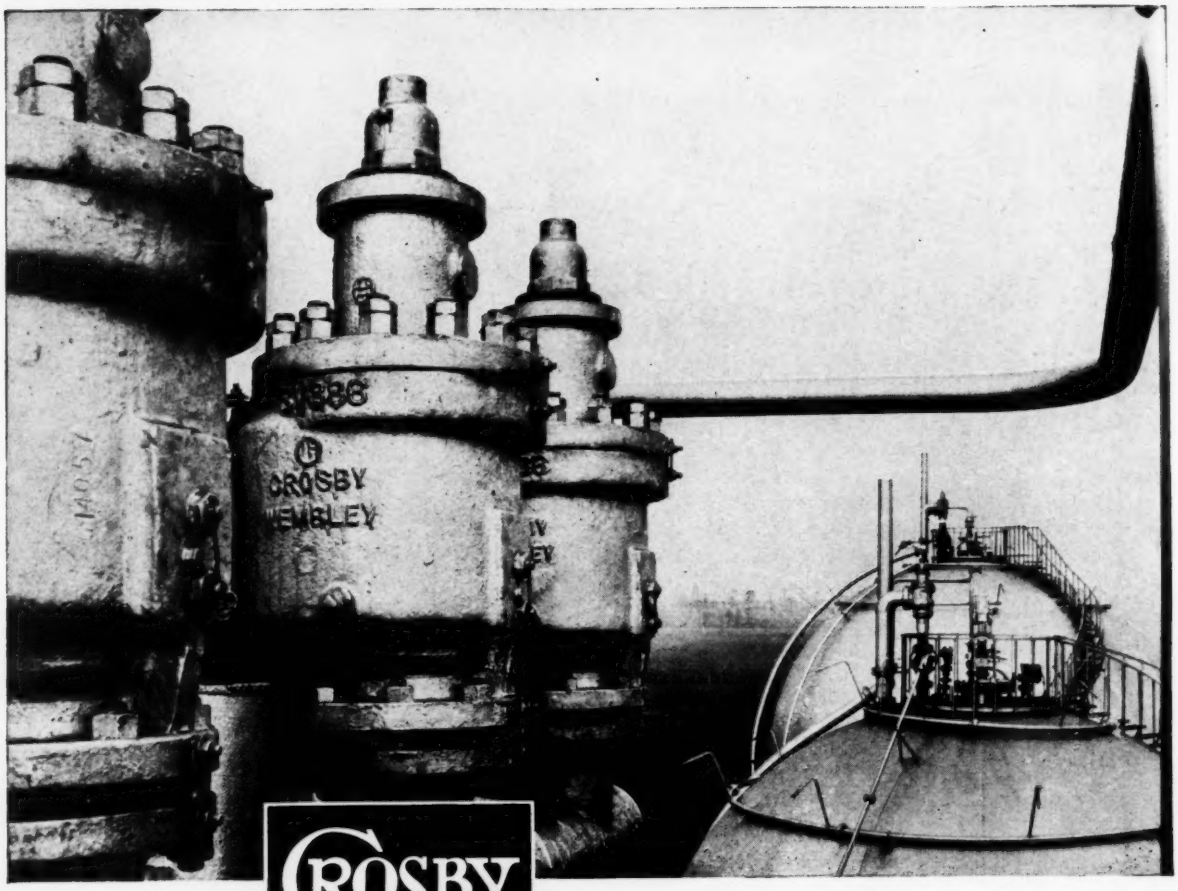

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MASONEILAN

SHELL USE EQUIPMENT AT SHELL HAVEN

Illustration shows three of four 6 x 8 Crosby Relief Valves together with Masoneilan Liquid Level Transmitters mounted on each of three Butane Storage Horton Spheres at Shell Haven. These relief valves protect the tanks from overpressuring.

The level instruments transmit the level of liquid Butane in the Spheres back to the Receiver in the control room. The reliability of this equipment is thus exemplified once again by one of the major oil companies of the world.

IMPORTANT ANNOUNCEMENT
Details are now available of the Crosby portable self-contained Safety Relief Valve Test Stand for Works or Site test purposes.

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wherever microwave research takes place you'll need Sanders INSTRUMENTATION

COAXIAL LINE OSCILLATORS

These oscillators employ low voltage, plug-in klystrons in coaxial line cavities covering the frequency range 1.30–12.00 kMc/s in three separate units. Each unit is equipped with a 0–100 db built in attenuator, and gives extremely high stability and calibration accuracy over a broad frequency band. A simple engraved scale giving attenuation calibration is provided on the CLC 2–4 and the CLC 4–7, the CLC 7–12 has an uncalibrated output attenuator for set-level purposes.

Type No.	*Valve Used*	*Frequency Range in kMc/s*	*Reset Accuracy in Mc/s*	*Calibration Accuracy*	*Variation Power Output at N Plug in mW*
CLC 7-12	CV 2346	7 to 12	better than ±½	0.1%	20 to 5
CLC 4-7	CV 2346	4 to 7	better than ±½	0.1%	20 to 5
CLC 2-4	CV 2116	1.3 to 4.5	better than ±½	0.1%	*20 to 5

Frequency Stability

Under Normal Laboratory Conditions: 2 parts in 10^5

Under Carefully Controlled Laboratory Conditions: 1 part in 10^6

** This is a minimum figure. Details of final test figures will be published shortly.*

This is one of a series on instruments and components by

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At existing industrial exhibitions only a very small proportion of the available space can be spared for the manufacturers and suppliers of drawing office equipment and materials. The visitor is, therefore, unavoidably denied the benefit of seeing a truly representative selection of these important items.

Now, for the first time, virtually every drawing office requirement will be available for you to make side-by-side comparisons of design, price, quality and value. Much of the equipment shown will be operational so that examination of actual results can help you in your selection.

You cannot afford to miss this o

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ND MATERIALS EXHIBITION

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supreme in performance · stability · consistency

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by Advance to be sure

TYPE HI

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TYPE HI

Frequency range 15 c/s to 50,000 c/s.
Sine or Square Wave output.
Output Voltage (High Impedance).
Sine Wave, 200 μV to 20 V, r.m.s.
Square Wave, 800 μV to 80 V, peak-to-peak.
Distortion less than 1% at 1,000 c/s.

Nett Price in U.K. **£30**

Full technical details in leaflet M41.

TYPE J1

Frequency range 15 c/s to 50,000 c/s.
Output (Sine Wave only).
Into 600 ohms, 0·1 mW to 1 W continuously variable.
Into 5 ohms, maximum 0·5 W.
Output impedance
600 ohms, unbalanced.
5 ohms, unbalanced (one side earthed).
Distortion, less than 2% at full output.

Nett Price in U.K. **£36**

Full technical details in leaflet M33.

TYPE J2

Identical with the Type J 1 but with output voltage meter.

Nett Price in U.K. **£42**

Full technical details in leaflet MB33.

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INSTRUMENTS DIVISION
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IT. GD/73

Circle 73 for further information

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Special Features

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Activities in the Industry ● Book Reviews

Some articles that have appeared in recent issues

An Analysis of Failure of Components
A. A. New, M.Sc., F.R.I.C., A.Inst.P

Precision Wirewound Resistors
D. C. F. Bartlett, B.Sc.(Eng.), M.S.M.A.

Microminiaturization, Reliable Components and Cooling Techniques
G. W. A. Dummer, M.B.E., M.I.E.E., Sen. Mem. I.R.E.

The Multi-channel Magnetic Head
C. W. Ross, A.M.Brit.I.R.E.

Potted Components K. A. Fletcher

Temperature Control for Crystal Pulling
J. I. Hopley

Protection of Electronic Equipment Against Vibration and Shock
J. A. C. Cramer, B.Sc.(Eng.)

The Phototransistor V. R. Chapler

Aluminium Soldering P. W. Wright

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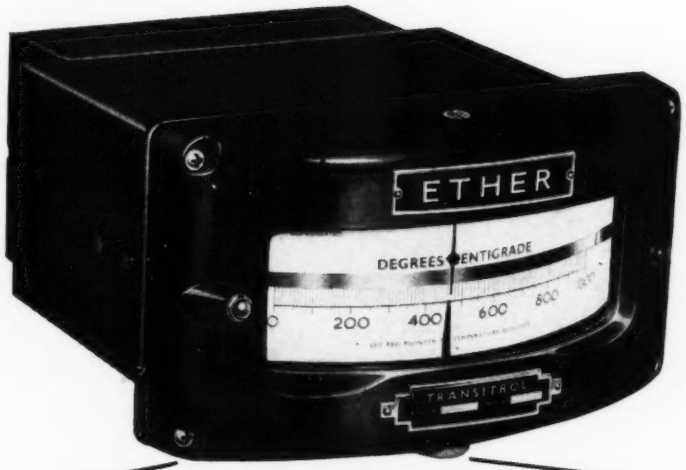
Patents 817053 & 819536

Regd.

Temperature Controllers



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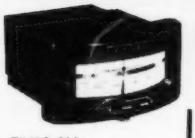
Agents in all principal countries.

TYPE 990:
Two-position on/off.

Operating:
Solenoid valves.
Motorised valves.
Contactors. Relays.
Electric heaters.

Applications:
Salt-baths for heat-treatment of metals.
Vitreous-enamelling furnaces.
Muffle furnaces.
Hot-air ovens.
Drying kilns.
Crucible furnaces.
High-temperature alarms.
Extruding and moulding machines, etc., etc.



TYPE 991:
Anticipatory

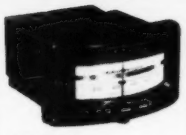
Operating:
Solenoid valves.
Motorised valves.
Contactors. Relays.
Electric Heaters.

Applications:
Extruding machines and moulding presses for plastics, rubber, etc.

Die-casting machines.

Furnaces for crystal growing.

Chemical processing.
Food packaging machinery, etc., etc.



TYPE 992:
Proportioning (stepless)

Operating:
Saturable reactors.

Applications:
Electrically-heated equipment requiring extremely accurate temperatures, e.g. plastic extruders for high-quality production.

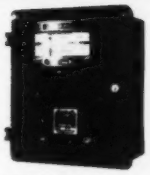
Electric furnaces employed on research.

Electronic production, etc., etc.

TYPE 993:
Three-position (employing any combination of the preceding control systems).

Operating:
Solenoid valves.
Motorised valves.
Contactors. Relays.
Electric heaters.
Saturable reactors.

Applications:
For the independent control of sequential heating and cooling or for controlling a floating valve in:—
Salt-baths for heat-treatment of metals.
Vitreous-enamelling furnaces.
Muffle furnaces.
Crucible furnaces.
Extruding machines.
Moulding presses.
Die-casting machines, etc., etc.



TYPE 995:
Continuously-acting Proportional (with manual reset)

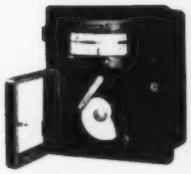
Operating:
Motorised proportioning valves.

Applications:
Gas-fired or oil-fired molten-metal vats.

Continuously-fed furnaces.

Lehrs.

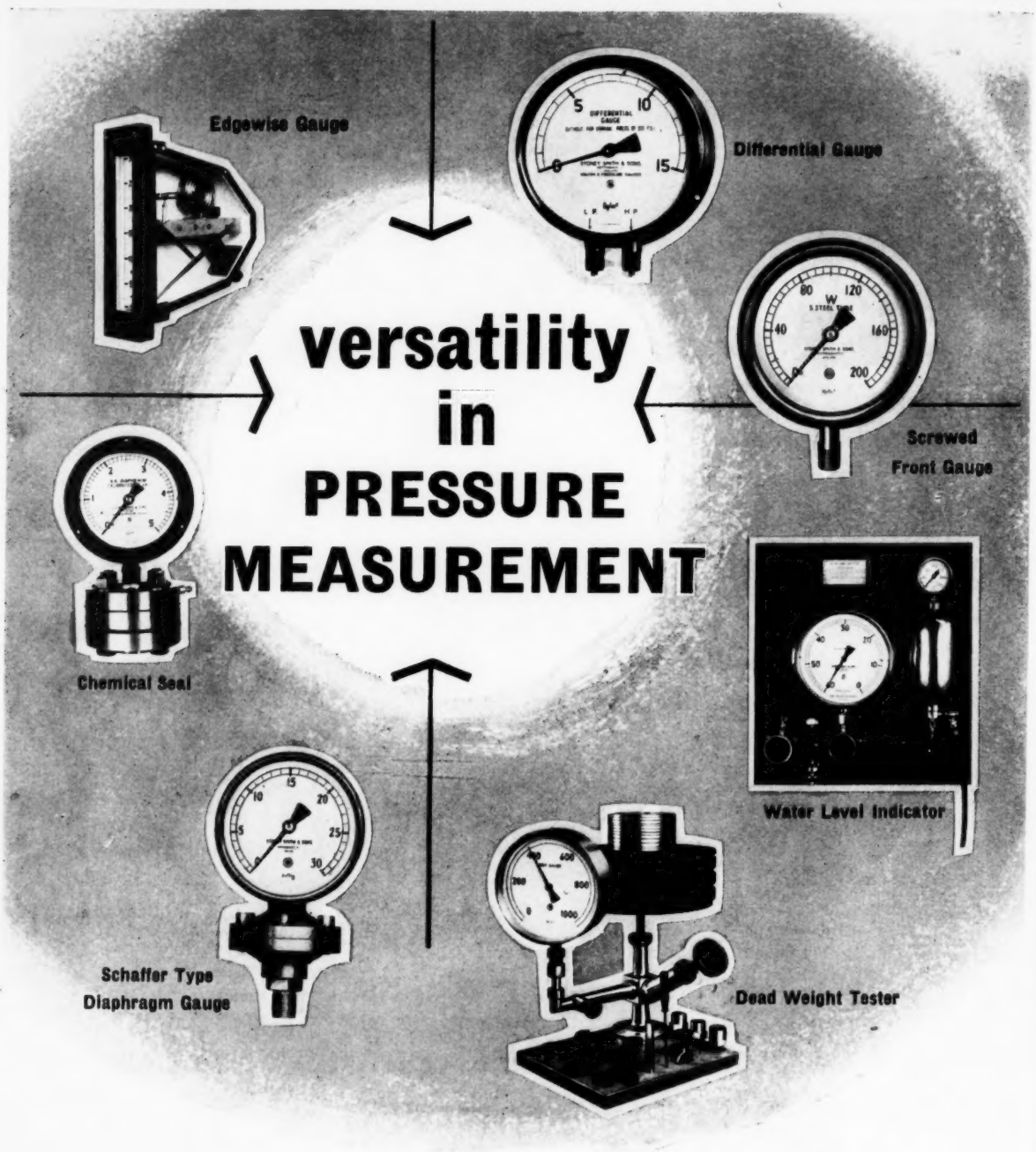
Drying ovens and kilns, etc., etc.

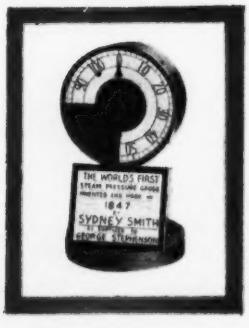


TYPE 994:
Time-Temperature (employing any one of the preceding control systems).

Operating:
Solenoid valves.
Motorised valves.
Motorised proportioning valves.
Contactors. Relays.
Electric heaters.
Saturable reactors.

Applications:
For controlling the rise and fall of temperature over a given period of time in:—
Pottery kilns.
Food processing.
Heat-treatment of metals, glass, plastics.
Research, etc., etc.





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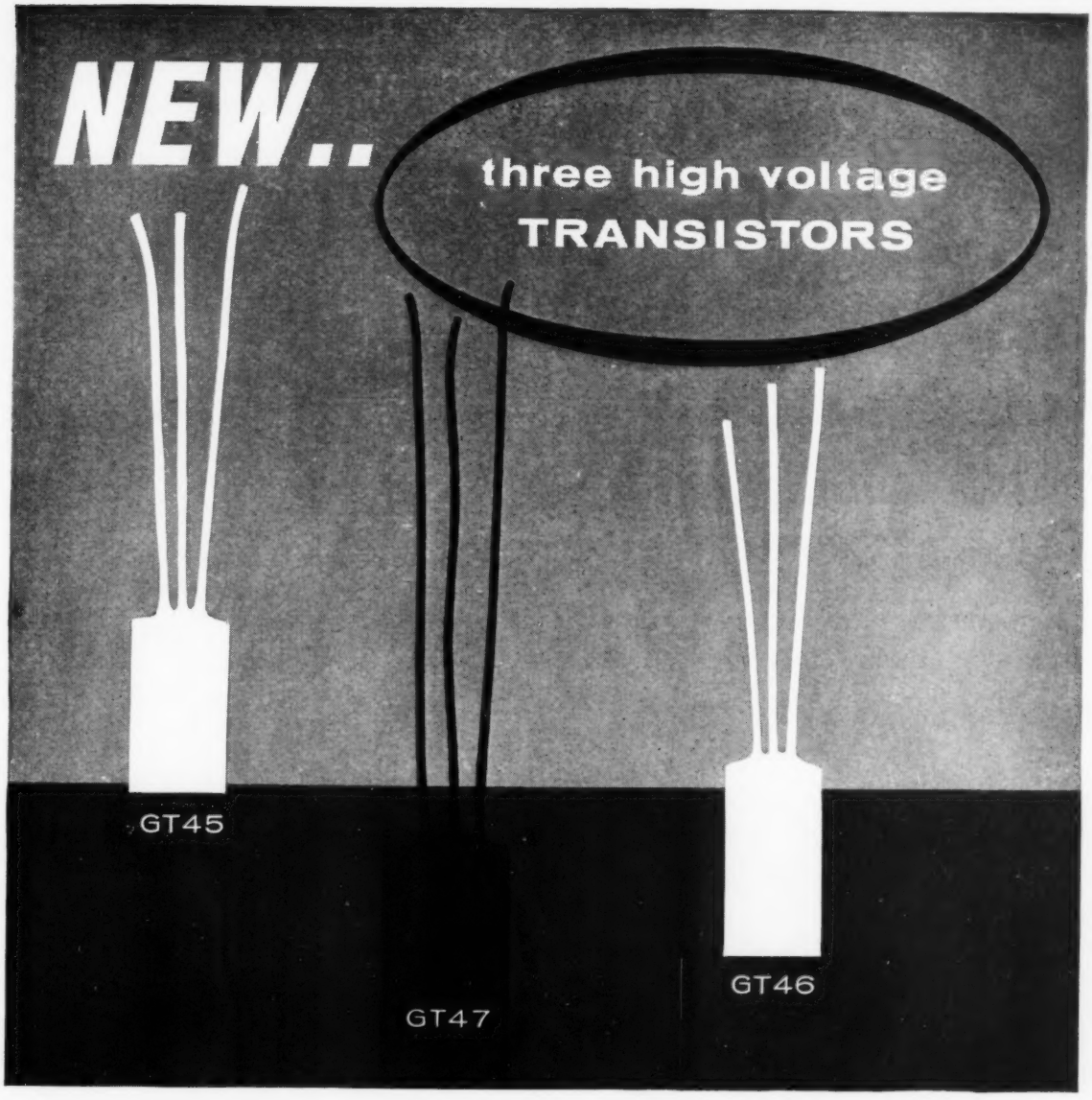

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FURTHER EXTEND THE AEI RANGE

For further details send for Descriptive List 4460 – 1 and Supplement—available from AEI Regional and District offices, or from the Electronic Apparatus Division of AEI.

RATINGS AND CHARACTERISTICS of these AEI transistor types are basically similar to the GT41–43 series as specified in AEI Descriptive List DL.4460–1 . . . *but with the following improvements:*

Max. peak or d.c. collector voltage—25V
Max. peak or d.c. emitter-base voltage—12V
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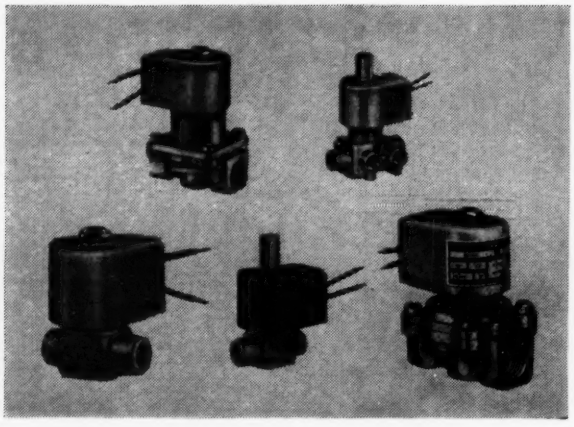

The world's most dependable Solenoid Valve manufactured under exclusive licence from the Automatic Switch Company of New Jersey U.S.A., by Dewrance & Co. Ltd.
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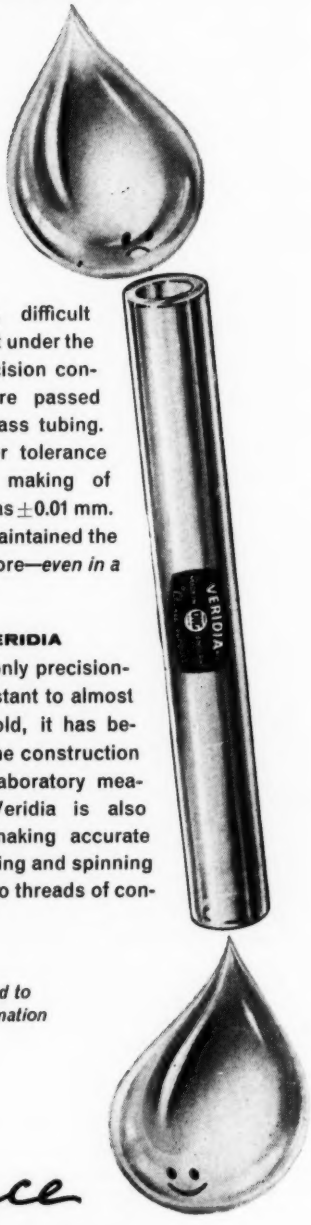

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As Veridia is not only precision-bore, but also resistant to almost all acids, hot or cold, it has become essential in the construction of industrial and laboratory measuring devices. Veridia is also widely used for making accurate jets, and for extruding and spinning plastic materials into threads of controlled diameter.

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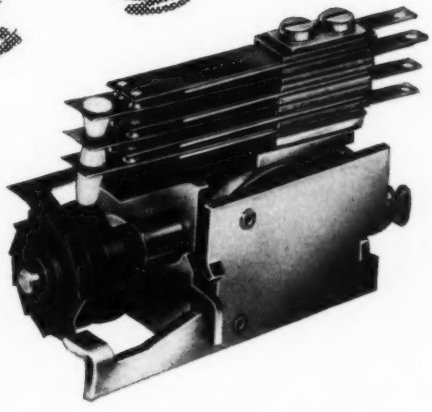
It's a **TMC** ZETTLER RELAY

and she's an electrical engineer



Well . . . we can't vouch for the woman. But we can for the Relay. It's one of the wide range commanding attention by offering decided advantages in every aspect of industrial control involving electrical and electronic equipment.
To be specific, it is the—

TMC ZETTLER (DIVIDE-BY-TWO) RELAY
TYPE AZ170

. . . a unique latching relay for the operation and release of contacts on successive pulses of the same polarity. A cam wheel is stepped at each operation of the armature by means of a ratchet and pawl mechanism. The contour of the cam is such that a simple springset is operated and released on successive operations. *This makes it a "divide-by-two" relay — its essential feature.* The armature is hinged on captive ball bearings for maximum reliability. Twinned, gold-flashed contacts have up to two change-overs and operating coils up to 110 volts D.C. It is particularly useful for remote control switching.

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Potentiometer Recording Controllers, SERIES 2000

Circle 80 for further information

TYPE 2000 with on/off control
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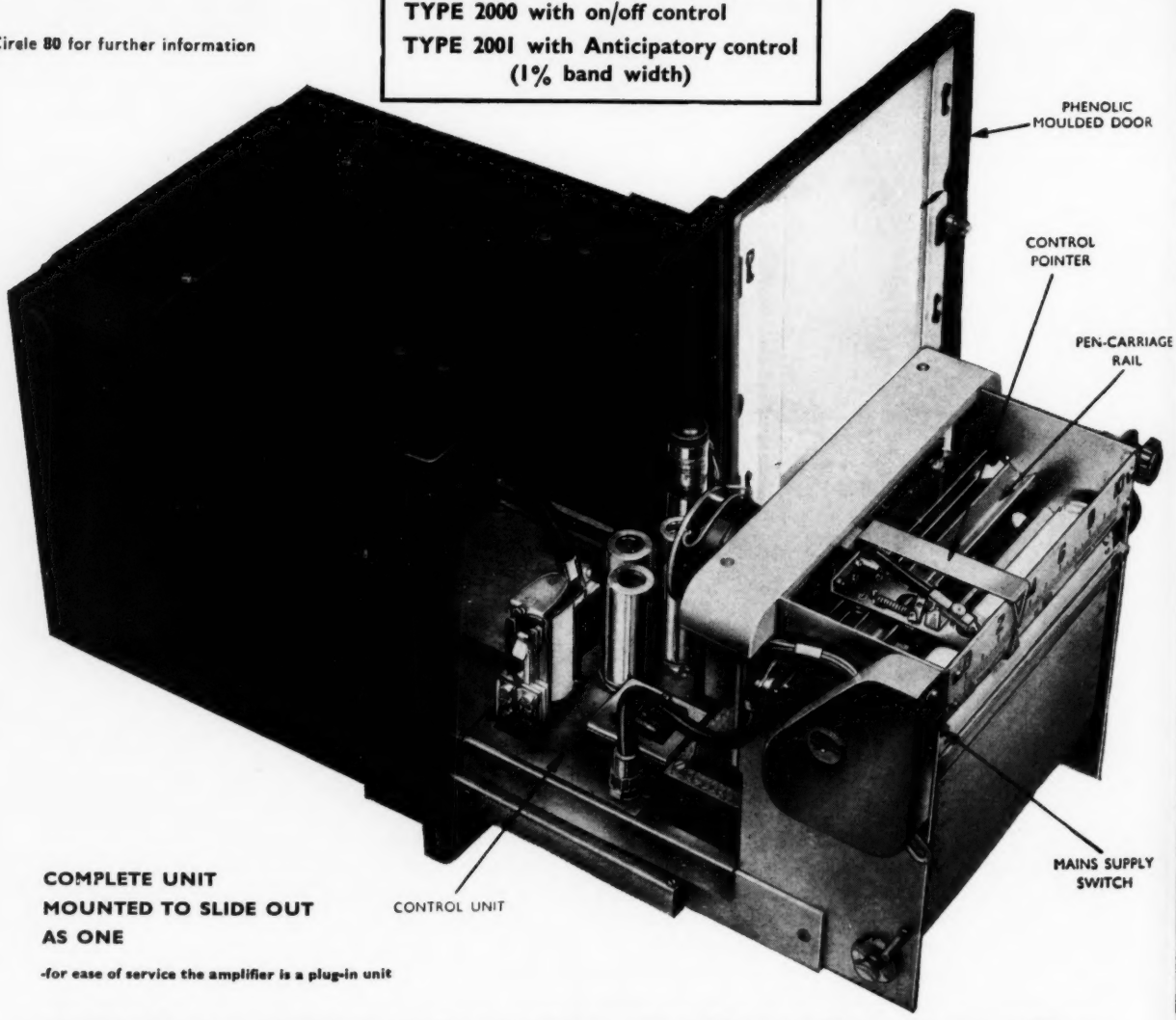

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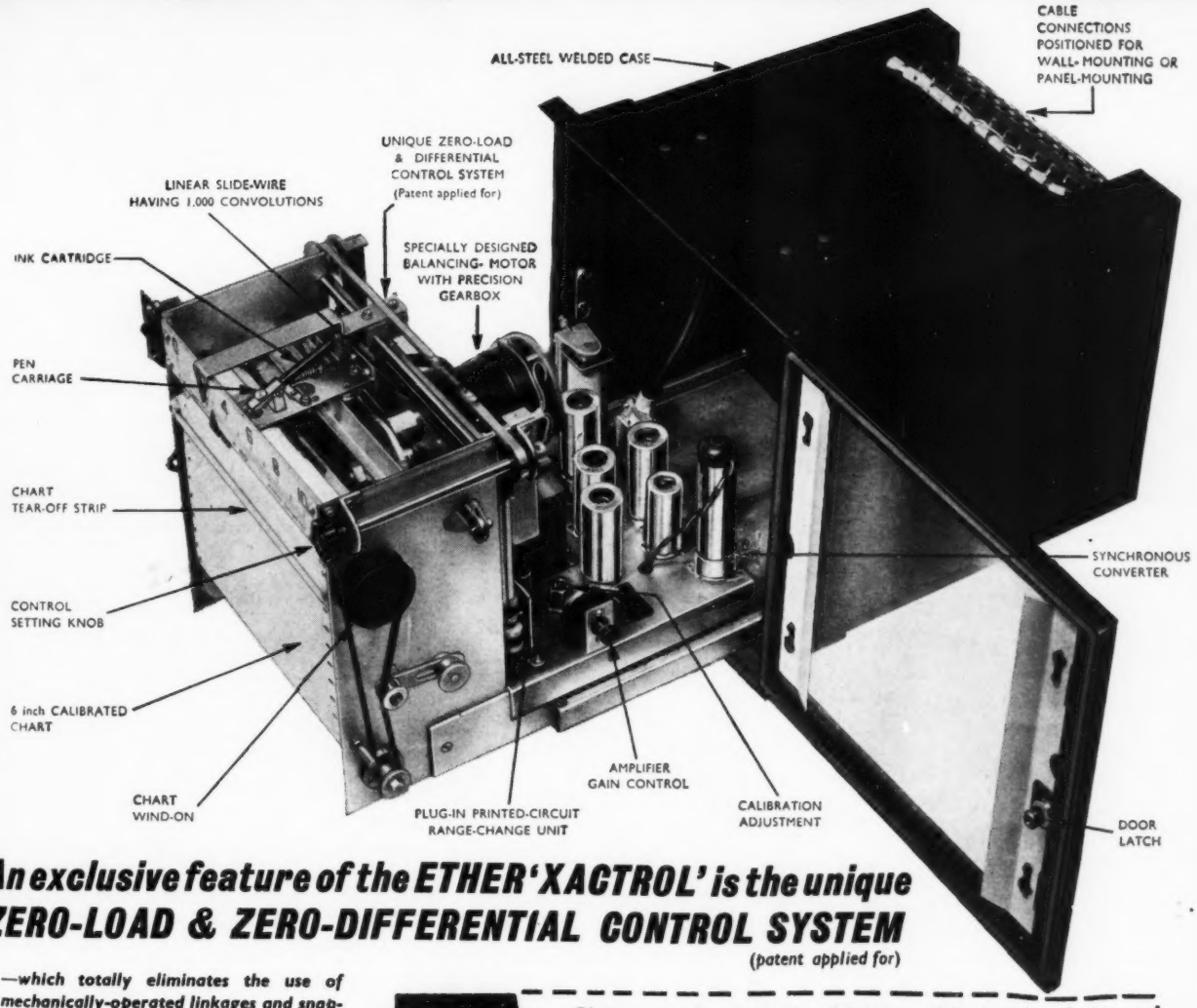
are high-quality instruments, of the very latest design, for accurately controlling and measuring temperatures of −200°C. up to +2,000°C. They are equally suitable for measuring variables, such as speed, strain, pressure and hydrogen-ion concentration, as well as any other quantity that can be expressed as an electrical signal.

* SIMPLICITY OF DESIGN * EASIER RANGE CHANGING

provide EVEN HIGHER STANDARDS OF PERFORMANCE

SALIENT FEATURES INCLUDE!

* Unique Zero-load & Zero-differential control system
* 6" calibrated scale * Small panel cut-out $10\frac{1}{2}$" $9\frac{1}{2}$"
* Patent Ink Cartridge * Front control-point setting



An exclusive feature of the ETHER 'XACTROL' is the unique ZERO-LOAD & ZERO-DIFFERENTIAL CONTROL SYSTEM

(patent applied for)

—which totally eliminates the use of mechanically-operated linkages and snap-action switches

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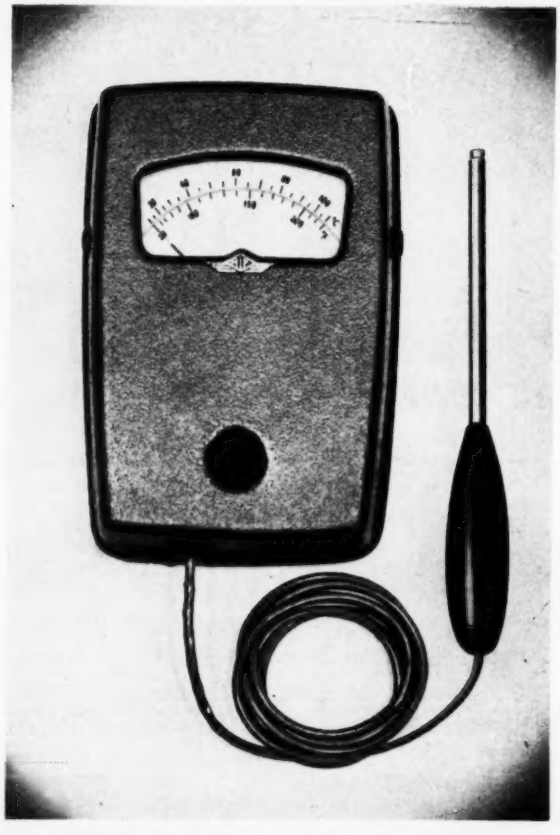

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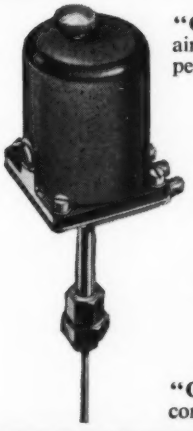
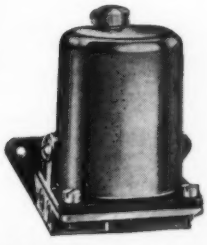


"On plant" mercury-in-steel air-operated proportional temperature controller.
Publication No. R39



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Mercury-in-steel air-operated temperature transmitter
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High thermal response. Wide range of temperatures.
Standard output air pressure, 3-15 p.s.i. Small and compact.

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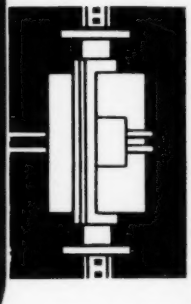
★ Outputs 0-15 mA and 0-50 mV

★ One, two or three flow ranges

★ Indicating milliameter for setting-up and checking incorporated

★ Built-in meter for setting - up and check - calibration procedures



Printed circuit construction, direct output for potentiometric and deflection instruments and up to three flow ranges are some of the advanced features of this new amplifier for use with the **ALTOFLUX FLOWMETER.**

Reliable, easy to maintain and cheaper than the Altoflux model which it replaces.

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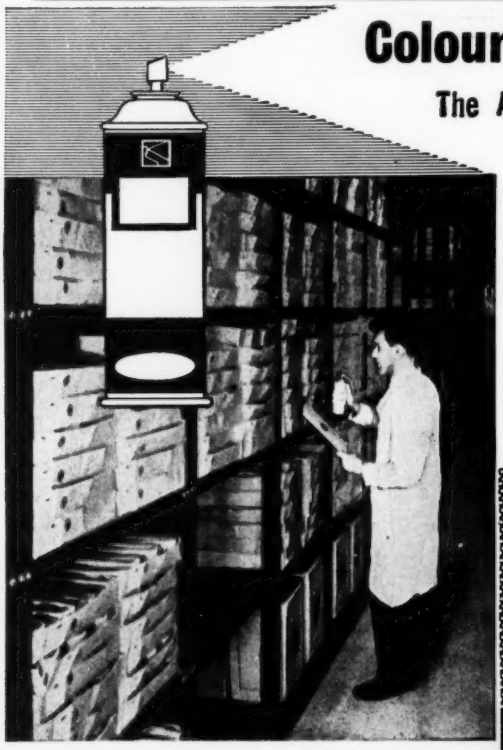
The AEROSOL method is quick, clean, economical



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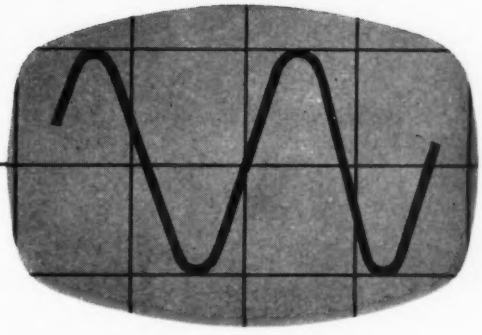

by Advance

the CVH RANGE

VOLSTAT

Advance constant voltage transformers are available in the CVH range with low harmonic distortion in the output waveform, ideal for use with precision equipment sensitive to power frequency harmonics, and also with all equipment requiring a constant voltage sinusoidal input.

In most applications the harmonic distortion present in the output waveform will not exceed 3%. Under the most unfavourable conditions this figure will not rise substantially above 5%. When used with a rectifier to provide a d.c. supply, the characteristics of the system are identical to the normal mains source and particularly close regulation of the output is obtained.

- **Continuous and Automatic Stabilization**
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Type	I/P V Range	O/P V r.m.s.	Watts	p.f.	Nett Price in U.K.
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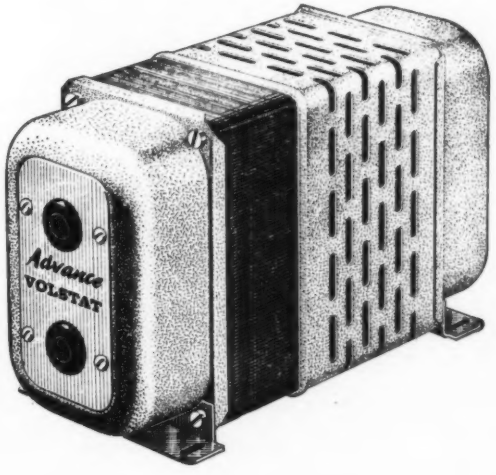
CVH125A	190-260 50 ~	230	125	1·00	£17 0 0
CVH420A	190-260 50 ~	230	420	1·00	£37 0 0
CVH750A	190-260 50 ~	230	750	1·00	£68 0 0
CVH1500A	190-260 50 ~	230	1500	1·00	£99 0 0
CVH3000A	190-260 50 ~	230	3000	1·00	£185 0 0
CVH6000A	190-260 50 ~	230	6000	1·00	£355 0 0



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MAINS STABILIZATION DIVISION

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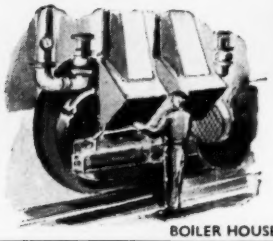
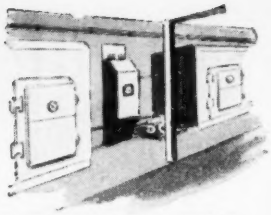
Rototherm

The DIAL THERMOMETER



BOILER HOUSES



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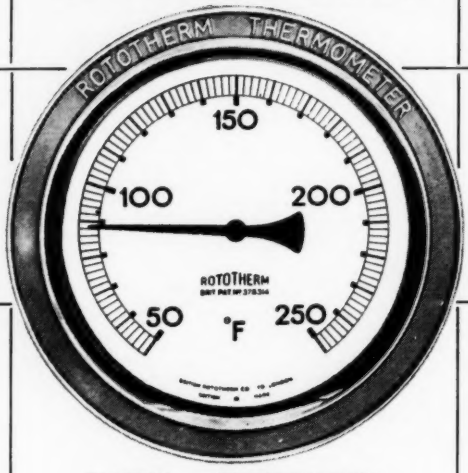

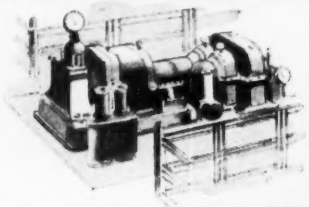

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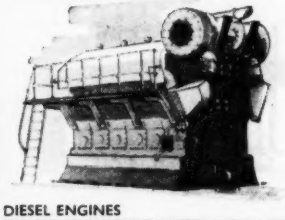

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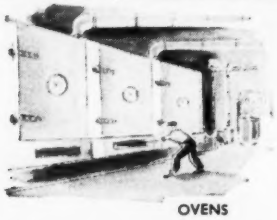

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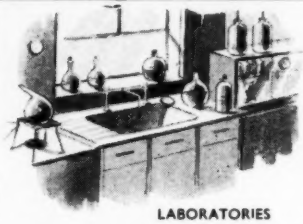

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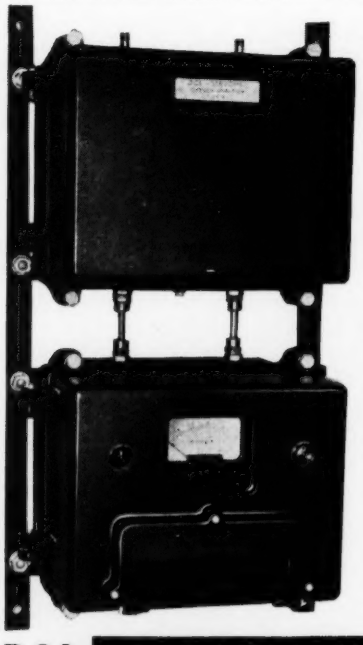

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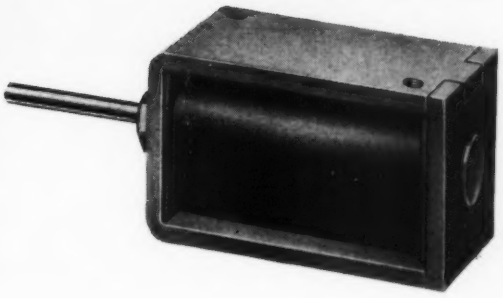

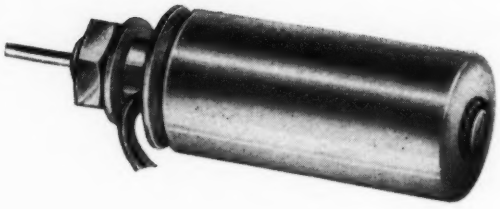

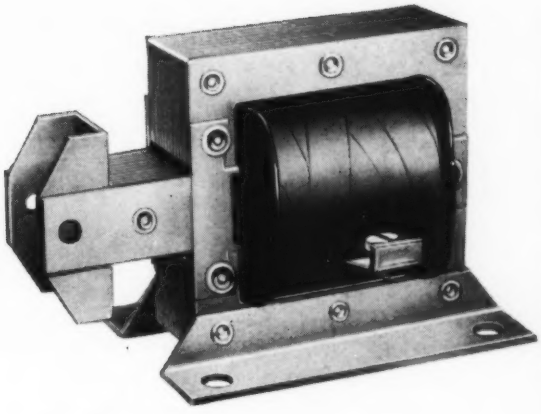

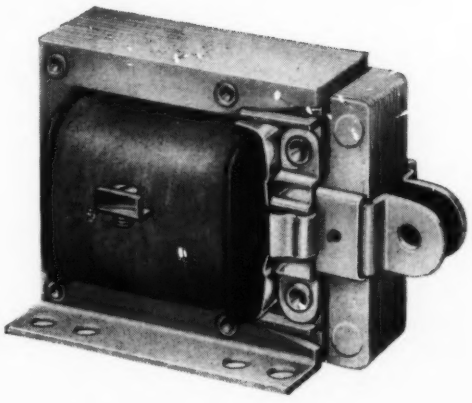

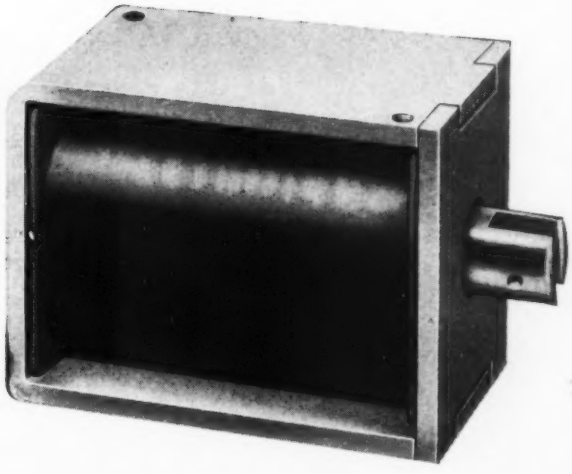

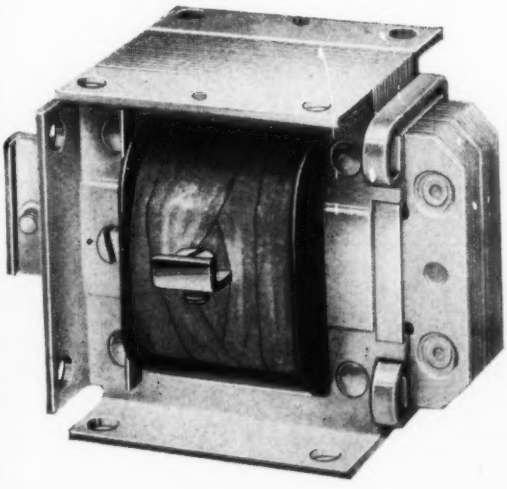

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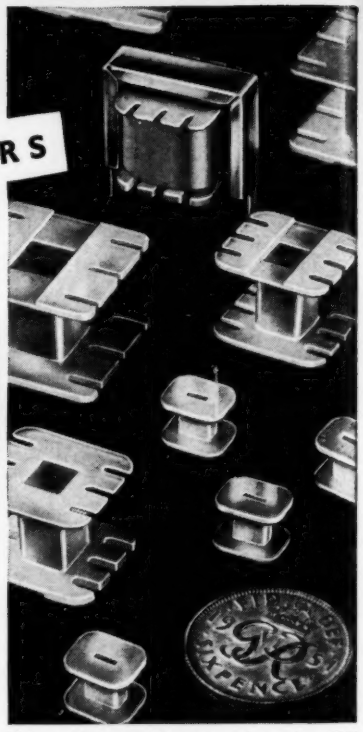

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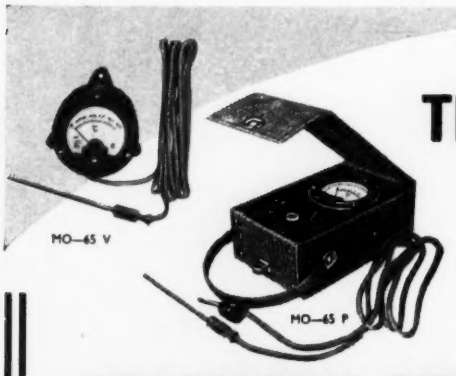

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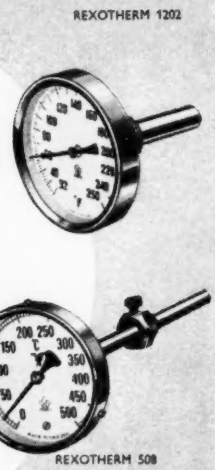

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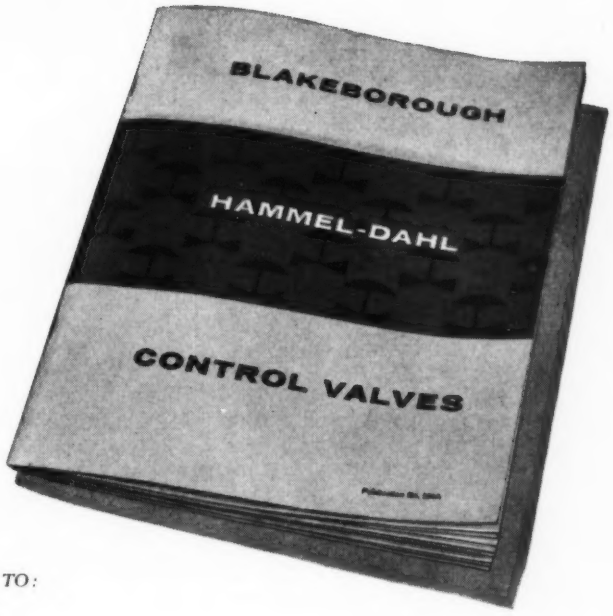

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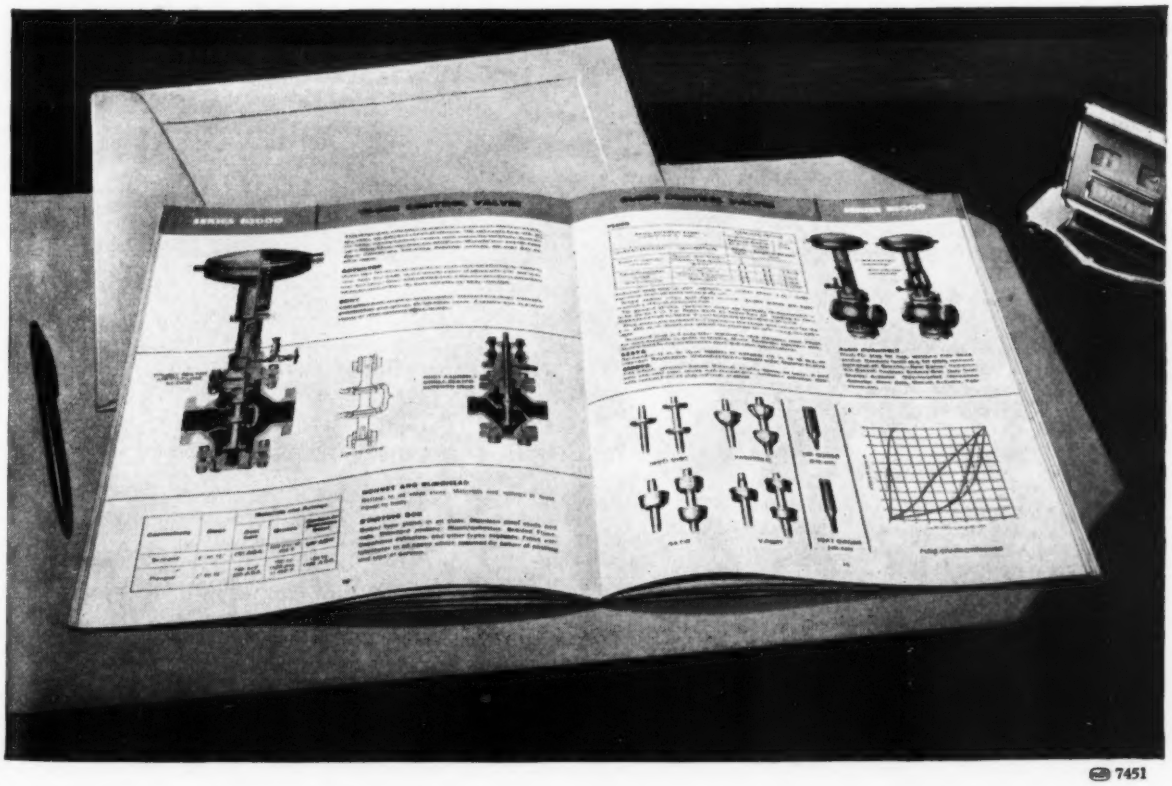

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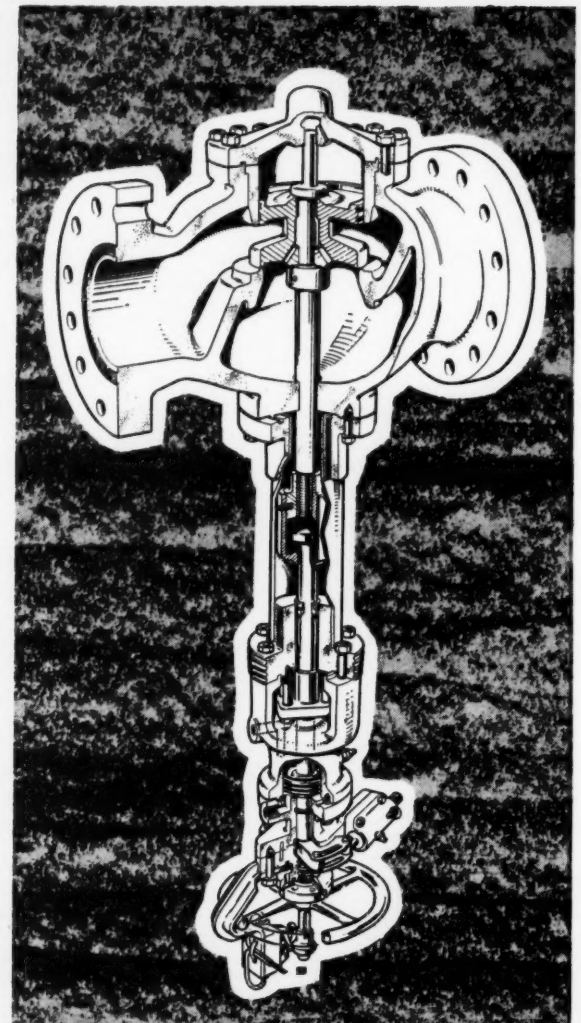

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Through-bore construction is employed and every winding is terminated at an isolated screw type terminal block thus eliminating all internal connections.

TECHNICAL SPECIFICATION

Number of windings	Stator ...	2
	Rotor ...	2
	Feedback ...	2
Excitation winding	Stator	
Excitation frequency	400 c.p.s.	
Voltage Rating	26/26 volts	
Test Voltage	15 volts	
Input Impedance, Nominal ...	480(±15%)+j2500(±10%)	
Transformation Ratio ...	0.98±0.01	
Phase Shift	8.5°±0.5°	
Resolution Error	0.1%	
Null Point Error	5 mins	
Total Null Volts	15 mV	
Fundamental Null Volts ...	8 mV	
Tuned Impedance, Nominal...	10,000 ohms	
D.C. Resistance (Nominal), ohms	390 Stator 320 Rotor 520 Feedback	
Moment of Inertia	9.25 gm cm²	
Weight	6.2 ozs	
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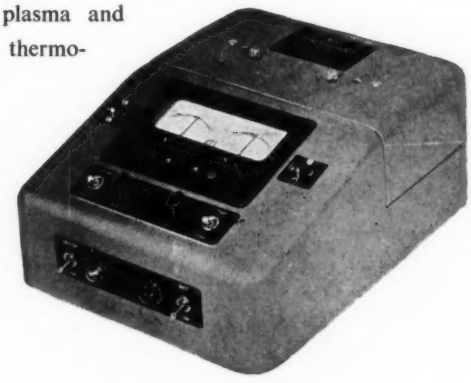
Prothrombin time measured photo-electrically

Both Quick's and Owren's methods for the determination of prothrombin times are well established in medical circles but the introduction of the "EEL" Prothrombin Meter has brought accuracy quite unobtainable with visual assessments. This photo-electric method also eliminates the constant cleaning essential with electro-mechanical devices, and the provision of expendable test tubes further reduces the need for spending time on this irksome task.

Construction

The instrument accommodates two test tubes for containing the blood plasma and reagents. It incorporates a thermostatically controlled unit into which the tubes are placed, light source and optical system to measure light transmitted through the samples, twin meters to measure the increasing turbidity and a relay controlled cut-out to stop the time counter automatically when the end point is reached.



"EEL" Prothrombin Meter

The two test tubes and identical measuring units permit either separate or duplicate tests to be made at the same time, although such is the accuracy of the "EEL" Prothrombin Meter, duplicate tests are seldom required.

Operation

The instrument is switched on and the necessary reagents added to the sample, the test tube being taken from a water bath. As calcium chloride is added to the sample, the time recorder is started. The tube is placed in the instrument and the meter set to a calibration mark after which the relay switch is put to "read". Upon coagulation a turbidity develops which will move the needle on the scale from its pre-set position to a point where the relay will actuate the automatic cut-out, leaving the prothrombin time indicated in seconds on the time counter. This apparatus is guarded against accidental alteration of this reading, once obtained. After the test has been started the operator may leave the instrument for other work.

The "EEL" Prothrombin Meter works from a mains power supply of 230 volts a.c., is completely portable and well tested, over 60,000 determinations having been carried out in a routine laboratory.

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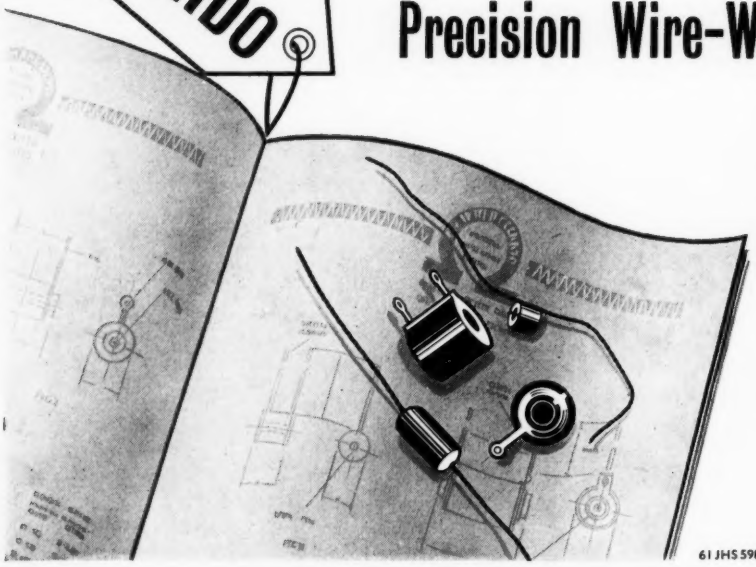

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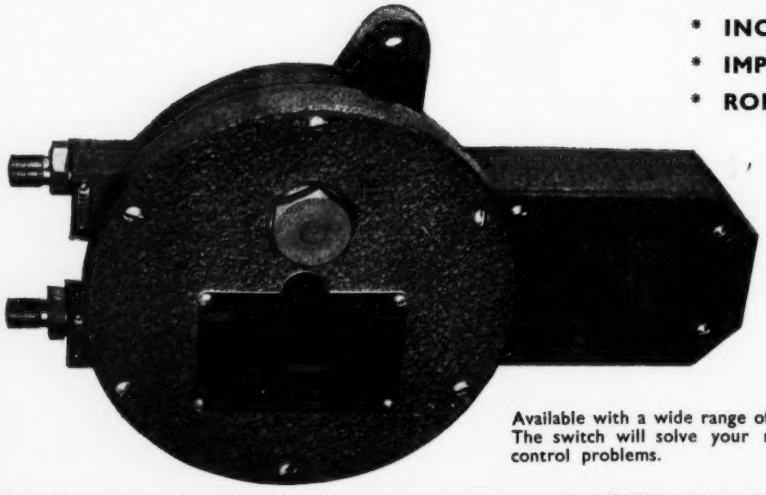

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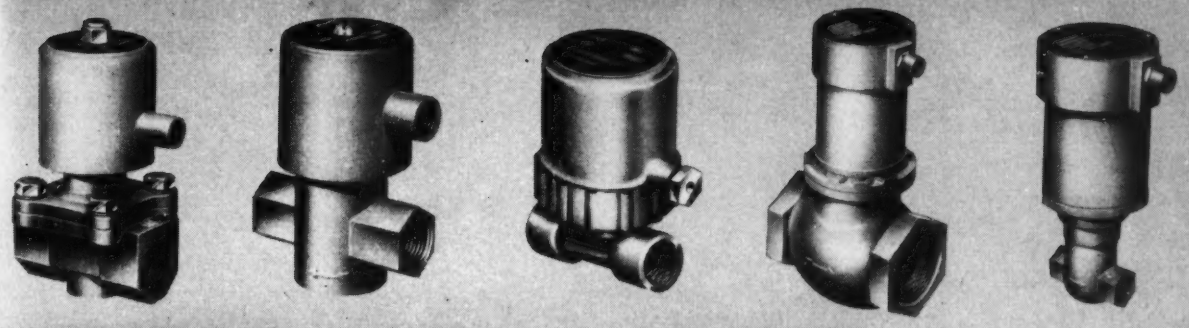

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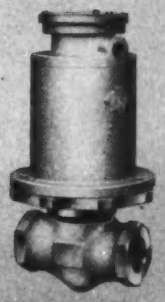

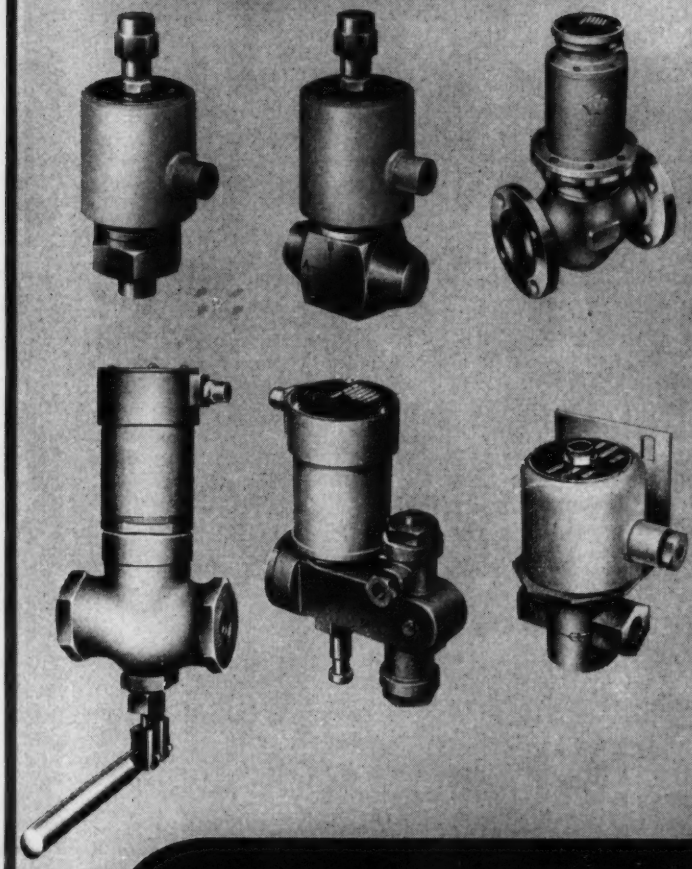

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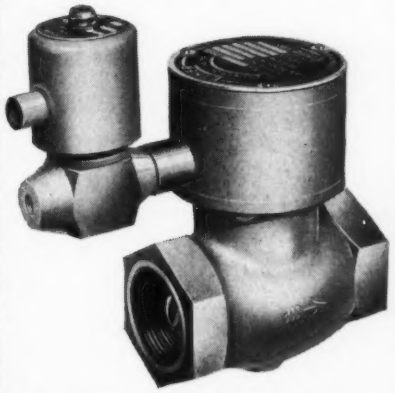

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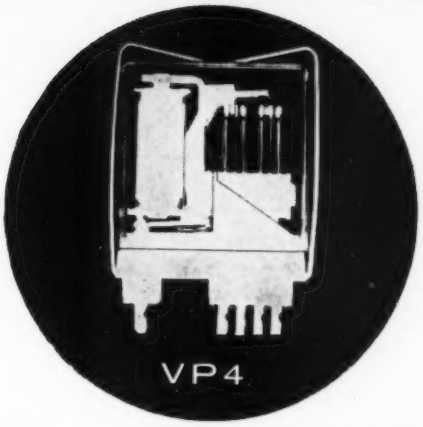

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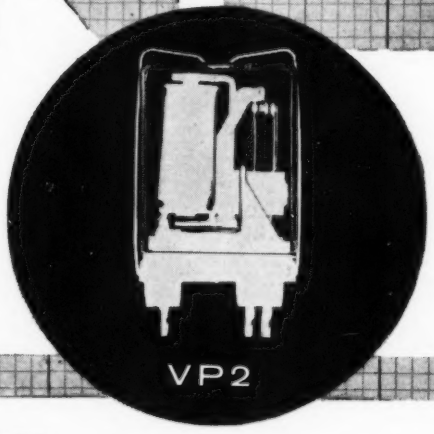

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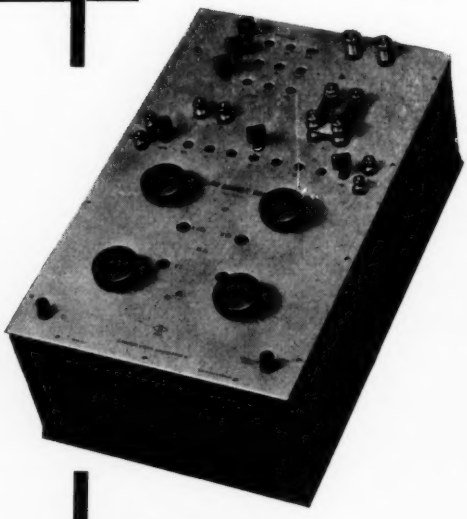

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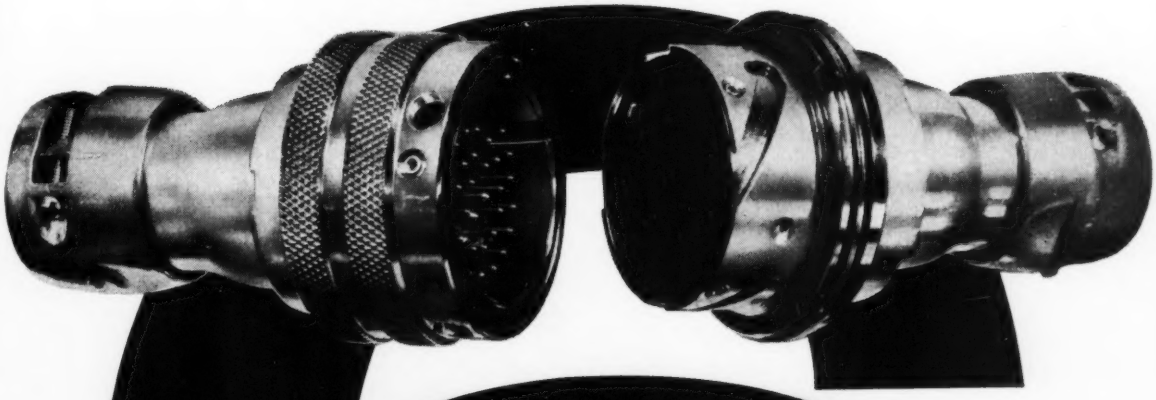

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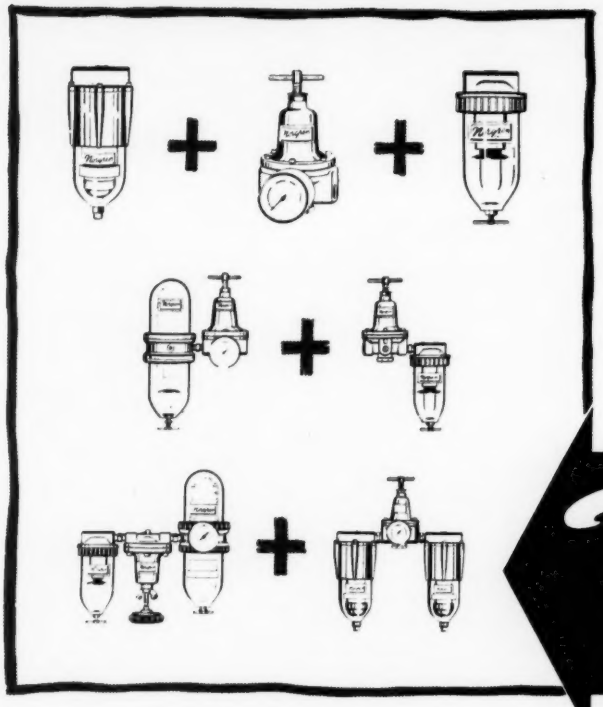

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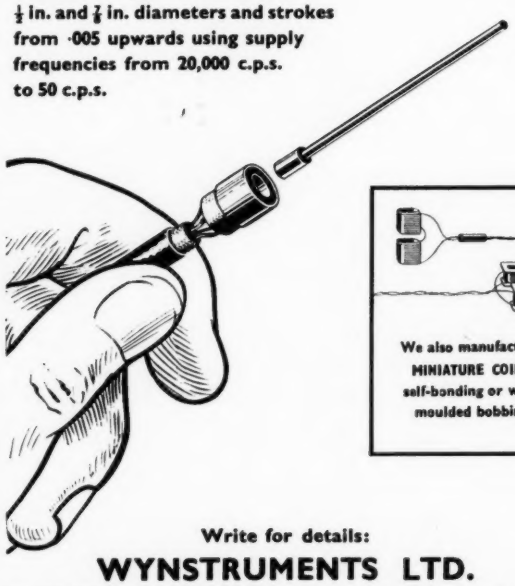

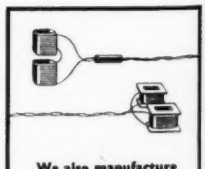

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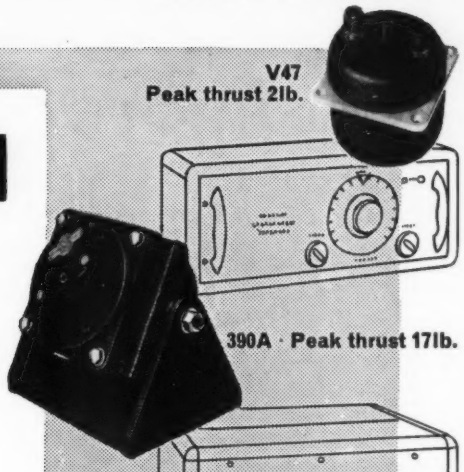

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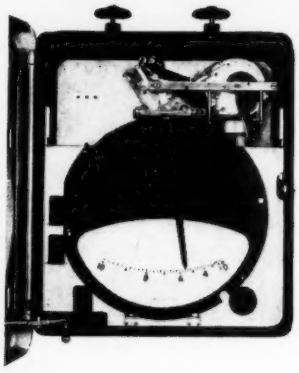

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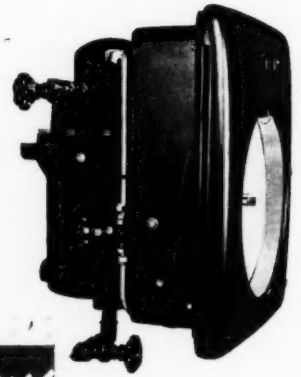

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CONTROL SYSTEMS-ELECTRONICS-AUTOMATION

Editor: J. T. Miller, B.Sc., F.Inst.P.

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VOL. 15. No. 2

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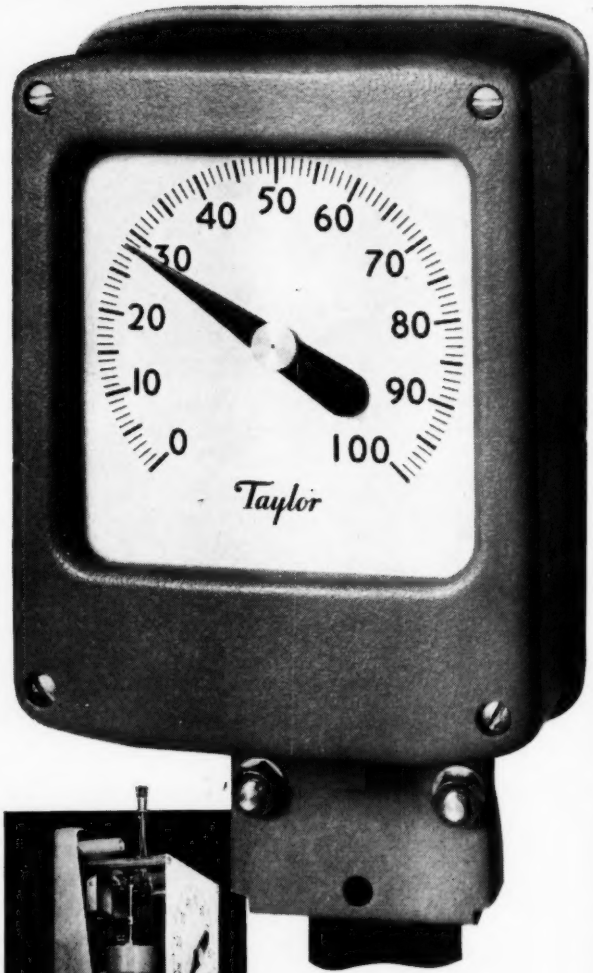

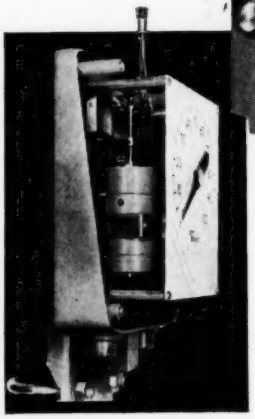

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INSTRUMENT PRACTICE

COMMENTARY

Technicians At the Annual General Meeting of the Society of Instrument Technology in May, 1960, the President, Mr. R. S. Medlock, gave an address on "The History of the Society".[1] In it he dwelt at some length on education, a subject in which the Society has been vitally interested since its inception.

Referring to early meetings of the Education Panel, the President said, "It was recognised that three types of instrument engineers were required: the artificer, who would deal with instrument maintenance and have a practical outlet; the technician, who would be educated in fundamentals; and the graduate technologist". Of these three, the Society has been much concerned with the technician grade and Mr. Medlock's immediate predecessor in office, Mr. Coales, gave considerable attention to this grade in *his* presidential address in May, 1959.[2] He suggested a broad classification, in so far as the highly automated industries were concerned, of installation engineers, maintenance engineers, plant operators, chargehands, foremen and test operators both for laboratory tests and quality control. It was necessary for the technicians to have a fairly wide technical training and to exercise more initiative than craftsmen who were only expected to acquire specialised skills with their hands. Mr. Coales included details of a three-year Ordinary National Certificate in instrument technology suitable as a basis for training technicians. But, as Mr. Medlock reports, the Society had, up to the time of delivery of his address, failed to get sufficient support for the setting up of a course for the instrument technician.

This state of affairs should be remedied if the recommendations in a Government White Paper, just published, are implemented. The White Paper, entitled "Better Opportunities in Technical Education" (Cmnd. 1254)[3], states "This White Paper contains proposals for a major reconstruction of the system of courses for technicians, craftsmen and operatives in the technical colleges of England and Wales". Briefly, the proposals envisage a broadening of the education received by the students, the adaptation of the system more closely to the needs of industry and an increase in the variety of courses available. It is hoped that the wastage due to the failure of students to complete their courses will be reduced substantially. Typical wastage figures may be found in the paper "Education in Instrument Workshop Technology" by J. F. Harrison.[4]

The main proposals are that students should start at a technical college immediately after leaving school, and that more care be taken in the selection of students for courses, a suggestion which will, no doubt, be heartily endorsed by many technical colleges. The courses will include those for National Certificates and Diplomas for students aiming to become at least high-grade technicians, and courses for the latter will be devised specifically for particular industries. Ordinary National Certificate courses will last two years instead of three, but there will be new courses of four or five years specially for technicians. New general courses will be introduced leading either to Technician or Ordinary National Certificate and Diploma courses. Sandwich courses for technicians should be increased. The variety of proposals is necessitated by the different requirements. At one end of the scale for technicians it may only be necessary to supplement a craftsman's course, whereas at the other end of the scale a qualification approaching degree standard may be required.

The new general courses, to which reference has already been made, may prove useful for selection purposes. These are designed for those leaving school at the ages of 15 or 16 and who show promise of being able to qualify as technicians. At 15, they will enter the general course and after a year they will proceed to the first year of a technician's course or after two years to the second year of a technician's course or the first year of the new two-year Ordinary National Certificate course. If the pupils leave school at 16, they will proceed to the first year of a technician course, or a one year general course, or to the second year of a technician course and so on.

The two other grades, i.e., craftsmen and operatives are discussed at length in the White Paper and present interest for the instrument industry.

Before closing this commentary perhaps one may be allowed to comment on Appendix A. This presents a list of bodies consulted by the Ministry of Education—53 in all. One looks in vain, however, for the Society of Instrument Technology, and yet various members of the Government have referred to the instrument industry as a major one!

References.

1. MEDLOCK, R. S. The History of the Society. *Trans. Soc. Instrum. Tech.*, **12**(3), Sept., 1960, pp. 107-117.
2. COALES, J. F. Presidential Address. *Trans. Soc. Instrum. Tech.*, **11**(4), Dec., 1959, pp. 203-212.
3. "Better Opportunities in Technical Education." Cmnd. 1254. H.M.S.O.
4. HARRISON, H. F. Education in Instrument Workshop Technology. *Trans. Soc. Instrum. Tech.*, **12**(4), Dec., 1960, pp. 200-204.

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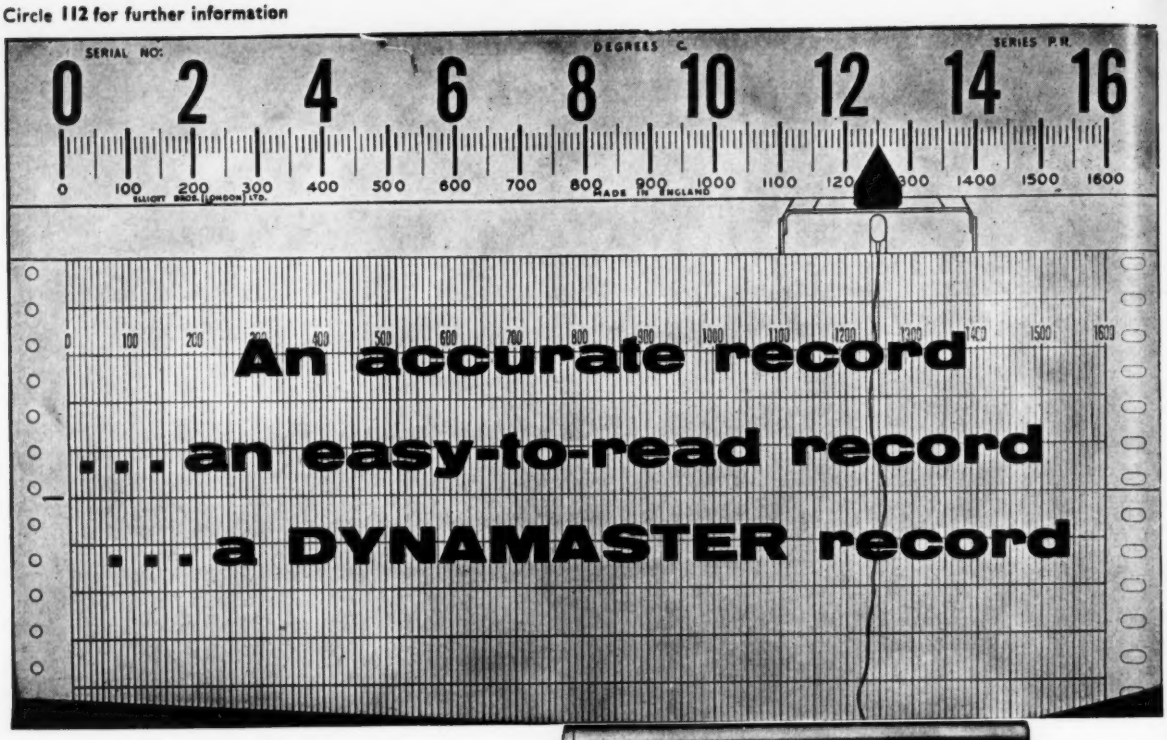
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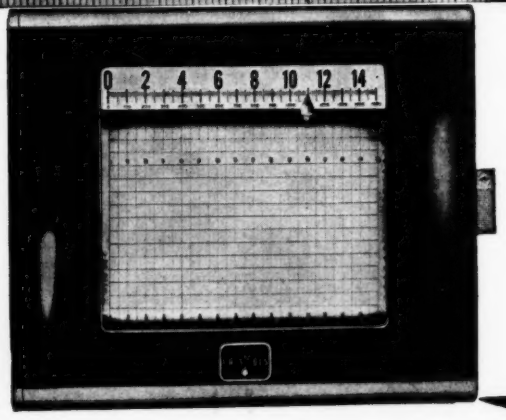

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Instrumentation in Fertilizer Manufacture

By A. T. BRAND, A.M.I.Mech.E.

and

J. C. FARQUHAR, B.Sc., A.R.I.C.

Introduction

IN June, 1959, Lord Netherthorpe, then President of the National Farmers' Union, officially opened a new chemical factory for Fisons Fertilizers Limited at Stanford-le-Hope, Essex. The factory is designed to accept liquid ammonia by pipeline from the adjoining works of the Shell Chemical Co. and to convert it first to nitric acid by a pressure oxidation process and then to ammonium nitrate solution by reacting the nitric acid with further ammonia. Some nitric acid is also purchased as such from the Shell Chemical Company.[1, 2]

The rated output is 450 tons per day of 88% ammonium nitrate aqueous solution. The solution crystallises at 85°C and is in fact stored at 120°C and loaded into insulated road and rail tankers at that temperature for transport to Fisons fertilizer compounding works. There it is used to enrich the plant-food nitrogen content of granulated fertilizers. The sensible heat of the solution is sufficient to keep the contents of the tankers liquid during their journey to works as far afield as those at Widnes and Plymouth.

The factory as a whole is comprehensively instrumented and the ammonium nitrate plant in particular is under fully automatic control, the start-up and shut-down sequences also being automatic.

The description of the instrumentation will be divided into three sections: Offsite including storage and services, Nitric Acid Plant, and Ammonium Nitrate Plant.

Offsite Instrumentation

1. *Liquid Ammonia*

The metering of liquid ammonia is carried out at the point of despatch at the Shell Chemical Co. site. A variable-area flow integrator and a Smithway positive displacement meter are placed in series in the line, and these are all checked periodically against a 12 ton capacity weigh-tank mounted on three Davy-United strain-gauge load cells, the outputs from which are summed and recorded on a Honeywell Controls ElectroniK recorder. The weigh-tank and load cell system is itself calibrated yearly, using dead-weights.

Liquid ammonia is pumped to Fisons' site through a 3 in. pipeline about one mile long, at a rate of about 6 tons/hour and at a pressure of 180 p.s.i. It is necessary to maintain the pressure in order to prevent vaporisation in the line, and this is achieved by a Fisher pilot-operated back pressure control valve situated next to the storage sphere at Fisons' site. Ammonia, with some flashing, passes through the valve and is admitted to the 60 ft diameter, 2,000 ton capacity sphere which is maintained at a pressure of 52·5 to 57·5 p.s.i. This corresponds to a storage temperature of 2·2 to 3·9°C. The pressure is controlled automatically by a pressure switch and simple on-off operation of the L. A. Sterne refrigeration compressors. There is a pressure recorder to keep a check on the operation of the system.

Liquid level measurement in the sphere is by a Shand and Jurs ST-9400 high pressure float-and-tape gauge which indicates at ground level. For emergency use a Sydney Smith differential pressure gauge is also fitted.

Liquid ammonia for the nitric acid and ammonium nitrate plants is pumped from the sphere by multi-stage centrifugal pumps at a pressure of 200 to 220 p.s.i.

2. *Cooling Water*

Thames water is used for process cooling and is re-circulated over a cooling tower at rates up to 22 ft^3/sec.

Because of the high salt concentration, there must be a constant purge and a corresponding make-up flow of up to $2\frac{1}{2}$ ft³/sec. A system was devised to provide automatic control of the circulating pumps, allowing for wide variations in plant cooling water requirements.

Treated make-up water and discharge from the cooling tower flows to an intake pond from which water is supplied to the plants by three (one spare) variable speed centrifugal pumps of 6,000 gal/min capacity each. The supply pressure to the plants is measured by a Honeywell Pressuretrol which feeds a signal to the Laurence-Scott Asrec pump motor speed controls. The Laurence-Scott system controls the speed of one pump to maintain constant water pressure and brings in or stops a second pump, as necessitated by demand. As the second pump cuts in, the leading pump reduces speed until both are sharing the load equally, then both are controlled to maintain the pressure. Similarly, as the second pump cuts out, the speed of the remaining pump is increased to avoid a momentary drop in pressure.

Water returned from the manufacturing plants collects in another pond from which it is pumped over the cooling tower by three (one spare) similar variable speed pumps. In this case the signal for the Laurence-Scott system is obtained from a potentiometer actuated by a level control float in the pond.

Purge and storm water flows to a sump equipped with float level switches arranged to start and stop one, two or three (as required) 7,000 gal/min constant-speed discharge pumps delivering back to the Thames Estuary. Flow rates of purge and make-up water are manually controlled.

3. *Nitric Acid Storage*

One 30 ft diameter by 24 ft high, and three 17 ft diameter by 32 ft high stainless steel tanks are installed for storage of 58% nitric acid. The three smaller tanks serve also to measure production and consumption. For this purpose contents measurement must be accurate, and Kelvin and Hughes mercury column air-reaction Pneumercators are used, with Williams and James Pneumerstat constant-flow bubbler units on the air supply. A small stainless steel separator vessel is mounted at the top of each dip-tube to prevent any damage by nitric acid splashing back into the measuring instrument in the event of sudden interruption of the bubbler air.

Pressure tappings are taken off the Pneumercators on two of the three smaller tanks and are led to a Bristol two-pen recorder in the plant control room. This instrument records the correct (or otherwise) operation of the shift tanks for production measurement purposes, as well as providing an indication of tank contents for the operators in the control room. In addition, Mobrey float-operated high level switches are fitted to all tanks and wired back to an alarm panel in the control room.

4. *Ammonium Nitrate Solution Storage*

Product is stored at 120°C in two thermally insulated tanks, one 80 ft and the other 56 ft diameter, both being 32 ft high. It is not easy to measure the contents of these tanks accurately, because the solution creeps and crystallises readily, both on losing heat or on losing moisture. Also, it is very corrosive.

The method finally adopted for accurate measurements for accounting purposes is carried out manually by lowering a stainless steel gauger's tape and bob-weight into the tank, with the tape rubbing against an insulated plate on the tank top. An Avometer is connected on the ohms range between the insulated plate and the tank top. When the weight touches the surface of the solution, the Avometer deflects sharply, and the ullage is read from the tape. The same method is used for checking the Pneumercators on the nitric acid tanks.

For less precise level indication, each tank is fitted (on a jacketed branch) with a Short and Mason Type 229R force-balance diaphragm-type level transmitter with constant-differential air relay. The air output is taken to a Kelvin and Hughes mercury manometer.

Storage temperature is maintained at 120°C by circulating through an external steam heater when necessary. Manual temperature control is adequate because of the great capacity and very slow response of the system. To prevent overheating of stagnant ammonium nitrate solution in the heat exchanger, the steam supply is fed through an Alexander Controls solenoid valve, arranged to close on failure of the ammonium nitrate circulating pump.

5. *Steam Generation*

While the nitric acid plant is being started, total factory steam demand rises to about 30,000 lb/h, the steam to the nitric acid plant being required at 200 p.s.i. and 540°F. When the acid plant is on stream, its power and heat recovery is such that it can export some steam, and the factory demand from the boiler house then falls below 15,000 lb/h.

To meet these requirements four oil-fired-packaged boilers were installed, together with a separately fired superheater. All boilers and the superheater are in operation during start-up of the nitric acid plant, and one boiler only at other times. The boilers are fitted with a standard packaged-boiler system of fully automatic control, which it is unnecessary to describe in detail. The oil burner of the superheater is controlled by temperature of the outlet steam, and the oil flow is cut off entirely on low steam flow. Because of the extremely high stack (150 ft), an Electroflo draught controller is fitted to maintain the draught in the boiler flues at approximately —0·05 in. w.g. This is necessary for optimum operation of the packaged-boiler open-loop combustion control.

Nitric Acid Plant

The nitric acid plant is of the pressure-oxidation type pioneered in the twenties by E. I. du Pont de Nemours and Co.[3], and, in this instance, modified and supplied by the Chemical and Industrial Int. of Nassau, Bahamas. A flow diagram of the unit is given in Fig. 1.

Referring to Fig. 1, air is compressed in an axial-flow turbo compressor to 120 p.s.i. and is then pre-heated to about 300°C and mixed with a maximum of 10·3% by volume of gaseous ammonia. The mixture reacts on a heavy multiple layer platinum gauze in the converter, according to the following equation:

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O + 216{\cdot}6k \text{ cal.}$$

Fig. 1. *Flow diagram of nitric acid plant*

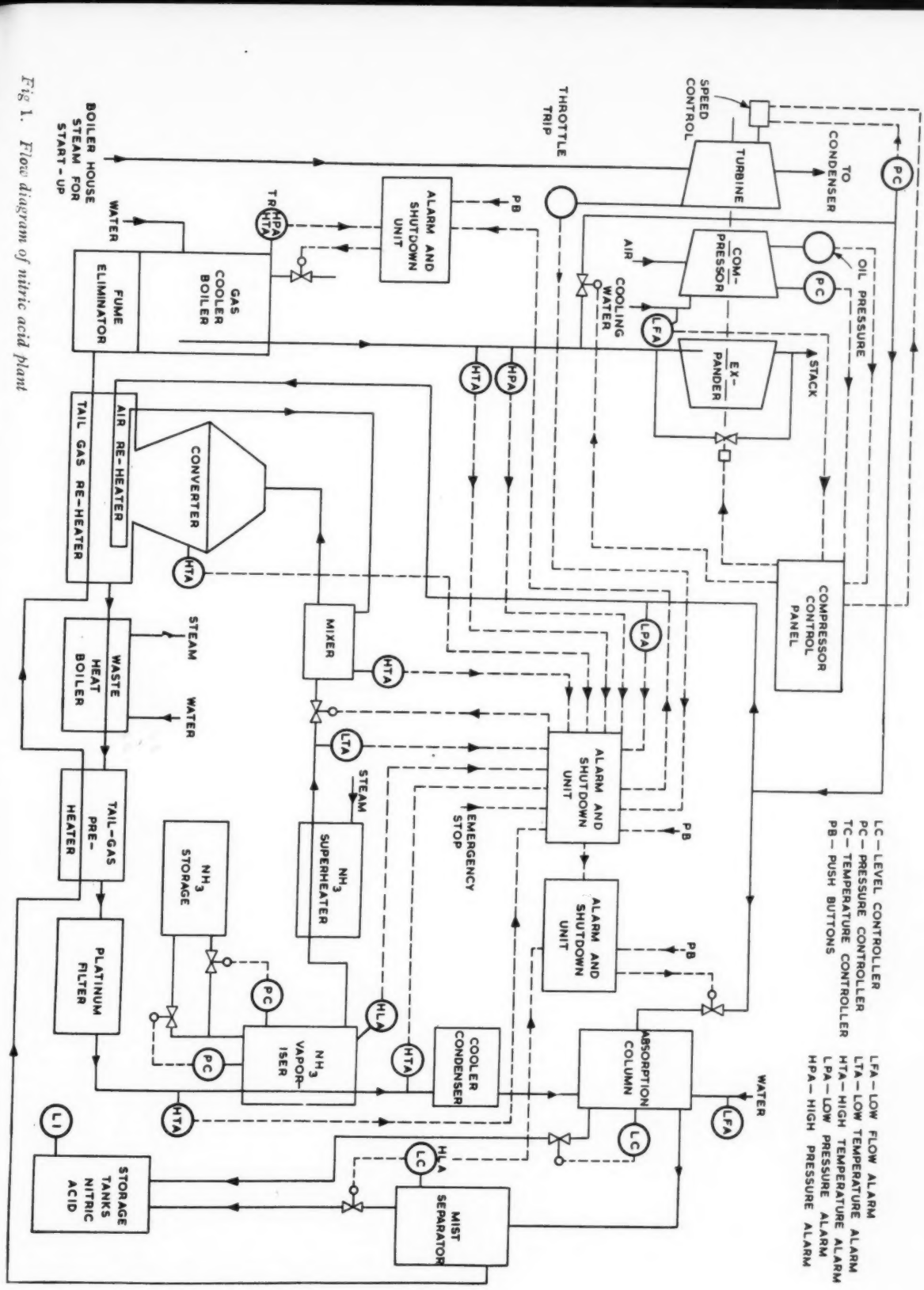


Fig 1. Flow diagram of nitric acid plant

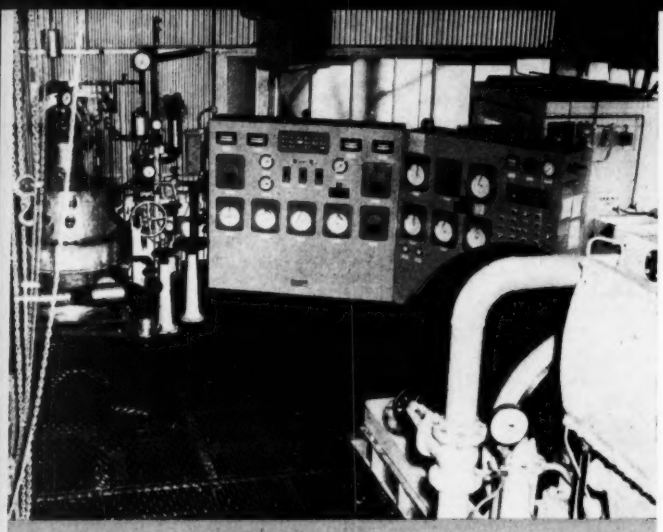


Fig. 2. Nitric acid and ammonium nitrate plant instrument panel (left and right respectively). Expander turbine in foreground

The heat of reaction is sufficient to raise the temperature of the gauze and products of reaction to about 940°C, as measured by a thermocouple placed directly under the gauze. Radiation effects are such that this is not the actual temperature of the gauze or reaction products, but it is nevertheless used for operating purposes as "the gauze temperature".

It is very easy to destroy the valuable gauze by overheating or by explosion, if the percentage of ammonia is raised too high. Platinum loss increases with gauze temperature and so does conversion efficiency[4]. It is, therefore, necessary to keep the gauze temperature as high as possible consistent with safety and platinum economy. These factors determine the instrumentation of the plant, which centres around an alarm and shut-down system whereby any dangerous condition will close a quick-acting Annin valve in the gaseous ammonia line to the converter. These dangerous conditions are listed later on, together with the instruments which provide the alarm/shut-down signals.

Leaving the converter, the hot gas flows to the air heater/tail gas re-heater where heat is lost to these two streams. It then continues to the waste heat boiler and superheater which is equipped on the steam and water side with conventional boiler instrumentation, including single-element level control by a Fisher Leveltrol, with the displacer installed in an external chamber. High and low level alarms are provided by two Ronald Trist Mobrey level switches, also mounted in external float chambers.

A Fisher Wizard pressure controller is fitted with its pressure tapping in the superheated steam main between the waste heat boiler and the turbine. The control valve for this instrument is installed in the saturated steam main from the steam drum of the waste heat boiler to the process and factory main.

Should the superheated steam pressure fall below 200 p.s.i. the control valve closes and all the steam generated by waste heat is fed via the waste heat superheater to the turbine. Whilst the pressure in the superheated steam main is above 200 p.s.i., the control valve opens to allow the surplus steam generated to be utilised in the process and for other factory requirements. After the waste heat boiler comes the tail gas preheater followed by a filter to save particles of platinum eroded from the converter gauze. The filter is followed by the ammonia vaporiser.

The gases still contain enough heat to vaporise the liquid ammonia received at a pressure of 200 to 220 p.s.i. from the pump at the ammonia storage sphere. This is achieved in a vertical-tube vaporiser, with the hot process gases flowing inside the tubes. There is also a separate steam heating coil for start-up purposes only. The start-up coil is mounted in the vaporiser at a height somewhat above the normal working level of liquid ammonia, so that, when a sufficient flow of hot process gases is established, the liquid ammonia level falls below the steam coil, and heat requirements for vaporisation are thereby automatically transferred from the steam to the process gases. The steam supply to the start-up coil can then be cut off at leisure.

Under normal running conditions the vaporiser pressure is controlled at about 150 p.s.i. by a Foxboro 3-term pressure controller, operating a $\frac{3}{4}$ in. control valve in the liquid ammonia feed line to the vaporiser. During transfer from start-up to normal running, excess ammonia must be released rapidly back to storage to prevent a rise in controlled pressure. This is achieved by a Fisher 2 in. pilot-operated pressure control valve, mounted in a line back to the storage sphere, and set at a slightly higher pressure than the Foxboro controller. The Fisher valve serves also to allow quick relief of high pressure on a crash shut-down. The vaporiser is, of course, also protected by standard relief valves. In addition, there is a float-operated high level alarm and shut-down.

The reaction products are still at about 120°C after leaving the vaporiser and must be cooled in the cooler-condenser (where some nitric acid is also condensed) before absorption in water in the absorption tower according to the equations:

$$2NO + O_2 \rightleftarrows 2NO_2 + 27{\cdot}1k \text{ cal} \quad \ldots\ldots (1)$$

$$3NO_2 + H_2O \rightleftarrows 2HNO_3 + NO + 32{\cdot}3k \text{ cal} \ldots (2)$$

NO produced in reaction (2) is again oxidised according to equation (1).

The heat generated by these reactions is removed by cooling coils in the absorption tower. To monitor any leakage of acid, an E.I.L. pH alarm is used for the cooling water outlet from the cooler condenser and absorption tower.

The tail gases leaving the absorption tower contain small amounts of NO_2 and this is removed by combustion with natural gas on a special catalyst in the fume eliminator, at a temperature of about 850°C.

A Foxboro temperature recorder with manual air station is fitted to control the admission of natural gas. The heat generated by the combustion is partly absorbed in the fume-eliminator boiler, in order to bring the gas down to a safe temperature for admission to the expander turbine. This boiler supplies steam to the same steam drum as used for the waste heat boiler, and water level and steam pressure controls (already described) are common to both boilers.

The main 7,000 h.p. axial flow turbo air compressor is driven by the expander turbine which provides about two-thirds of the power, and by a steam turbine which

provides the remainder. Control of outlet air pressure is achieved by a Foxboro two-term pressure controller which regulates the steam turbine governor. An anti-surge control is fitted to the Brown Boveri compressor, and controls the surge by bleeding or restricting air from the compressor, through an hydraulically-operated valve to the expander. The control consists of a differential measuring bellows fitted to a three-term hydraulic controller, the impulse tappings being on each side of the second stage of the compressor.

Automatic Shut-down and Alarm System

Gas to Expander Turbine, High Pressure

In event of high pressure of the tail gas to the expander, the alarm and shut-down is effected by a Foxboro pressure indicator fitted with individually adjusted rota contacts; one set actuates the alarm system, and the other set actuates the shut-down.

The settings are so arranged that an alarm occurs before a shut-down is initiated.

Gas to Expander, Low Temperature

The temperature of the gas to the expander is measured by a Foxboro temperature recorder, fitted with two sets of rota contacts for operating the alarm and shut-down circuits. The contacts have a fixed differential setting to operate the alarm circuit prior to the shut-down.

The measuring element is a class 3B vapour pressure system, the bulb being fitted into a stainless steel pocket.

An additional thermal system is fitted to this instrument to record only the temperature of the tail gas to the fume eliminator.

Tail Gas to Expander, High Temperature

The alarm and shut-down functions for high temperature gas to the expander are controlled by a Negretti-Zambra R145 dial thermostat. This instrument has a mercury in steel thermal system with a stainless steel bulb and stainless steel pocket. The unit has a suppressed range and is fitted with an adjustable set point which determines the operation of a single pole mercury switch. The differential of this instrument is stated to be 2½% of the scale range.

Process Air Low Pressure

The process air pressure is controlled by a Foxboro Model 40 two-term indicating pressure controller, fitted with rota contacts. The pneumatic output from this instrument is fed to the speed control of the steam turbine.

The normally closed rota contacts are arranged so that the alarm signal functions prior to shut-down on low pressure.

Converter Gauze High Temperature

The gauze temperature is recorded on a Foxboro Dynalog electronic circular chart recorder, used in conjunction with a platinum/platinum-rhodium thermocouple housed in a stainless steel pocket. The instrument is also fitted with individually adjusted rota contacts to open circuit on high temperature conditions. One set of contacts, which is set at a lower value than the other, operates the alarm system whilst the second set initiates a shut-down.

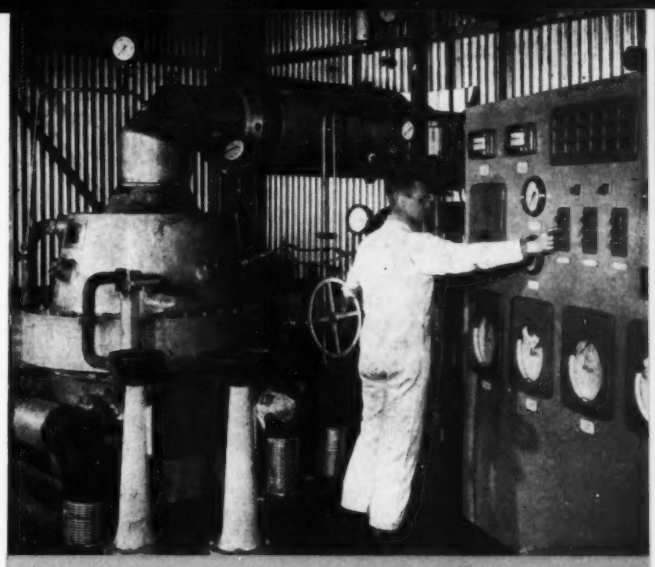


Fig. 3. Nitric acid plant, converter and control panel at start-up

Fume Eliminator Catalyst High and Low Temperature

The fume eliminator catalyst temperature is measured by two Pyrotenax integral sheathed Chromel/Alumel thermocouples situated above and below the catalyst bed. The e.m.f. produced is fed to two electro-pneumatic converters which give 3-15 p.s.i. output signals to the two receiving elements of a Foxboro recorder.

Pressure switches are inserted in the output signal lines of the converters and so adjusted to initiate the alarms and to shut-down the natural gas feed valve to the fume eliminator.

Low Ammonia Vapour Temperature

The instrument which performs this function is a Foxboro temperature recorder. The vapour pressure thermal element has a stainless steel bulb fitted into a stainless steel pocket located in the vapour line between the ammonia superheater and the gas mixer.

Individually adjusted rota contacts are fitted for the purpose of operating the alarm and shut-down circuits.

Mixer Gas High Temperature

The mixer gas temperature is measured by a vapour pressure thermal system, fitted with a stainless steel bulb and pocket. The recorder is a Foxboro instrument with individually adjusted rota contacts, adjusted to alarm and shut-down under high temperature conditions.

Nitric Oxide Gas to Ammonia Vaporiser and Cooler Condenser High Temperature

Four Ether Transitrol indicating controllers are installed. Two controllers are used in the line to the vaporiser and two in the line to the cooler condenser. One of each pair operates the alarm system whilst the other operates on shut-down conditions. The controllers are galvanometer type instruments fitted with adjustable set pointers, and receive their operating signals from iron constantan thermocouples assembled in stainless steel pockets. Each instrument is equipped with cold junction compensation.

Ammonia Vaporiser High Level

In the event of a high level condition occurring in the ammonia vaporiser, a Mobrey level switch, with a stainless steel float assembled in an external chamber, operates both alarm and shut-down circuits simultaneously.

Turbine Throttle Trip

A roller-operated switch positioned adjacent to the turbine throttle trip mechanism is brought into operation should the steam turbine trip out. Simultaneous action is initiated for both alarm and shut-down units.

Emergency Stops

Several Square D shrouded push-buttons are installed at various points within the plant, to enable a shut-down to be accomplished in the case of emergency.

Other Shut-downs and Alarms on Turbine/Turbo Compressor System

An electrically-driven oil pump provides sufficient oil pressure for the hydraulic and lubricating oil systems. A stand-by steam-driven oil pump is arranged to cut in automatically in the event of pump failure. A mechanically-driven oil pump, coupled to the compressor shaft, provides bearing lubrication in case of total failure.

Both the lubricating oil and hydraulic oil systems are also fitted with pressure switches wired to shut down the turbine in event of pressure failure.

The cooling water system is equipped with a differential pressure switch, with tappings on the inlet and outlet of the cooling jacket. The switch contacts are wired into the safety shut-down circuit on the compressor panel.

In the event of the safety shut-down circuit being operated, or in the event of power failure, a solenoid valve situated in the compressor control panel de-energises, and by-passes the hydraulic oil back to the reservoir. The decrease in pressure causes the throttle trip to operate and allows the compressor to come slowly to rest. An electric switch operated by the throttle trip shuts down the ammonia feed valve together with the remainder of the nitric acid plant. At the same time, the gas to the expander is by-passed to atmosphere. For the period in which the compressor is coming to rest, the plant is being purged by clean air.

Ammonium Nitrate Plant

The ammonium nitrate plant employs the Stengel process developed in America by Commercial Solvents Corporation. It is the only one of its kind in Britain. A flow diagram of the process, showing main instrumentation, is given in Fig. 4.

Referring to the diagram, 58% nitric acid is preheated, mixed with gaseous ammonia, and passed into a vertical reactor packed with stainless steel rings. Reaction takes place according to the equation:

$$HNO_3 + NH_3 \rightarrow NH_4NO_3 + 25{\cdot}5\text{k cal}$$

A fog of ammonium nitrate is formed which coalesces to a mist on the reactor packing rings, and this passes into the cyclone separator at high velocity. Here the steam (produced by the heat of reaction) is driven off, through the ammonia vaporiser, into a total condenser, past a pH controller, and to drain. The ammonium nitrate is pumped to storage from the cyclone separator as a hot 88% solution.

Although the process is simple and the plant itself is small in dimensions (the reactor is only 1 ft 6 in. diameter and 15 ft long) the instrumentation is extensive and complex. All major conditions are under automatic control and there is a fully automatic electro-pneumatic sequencing system for shut-down, purging, and washing. Start-up is partly automatic and interlocking ensures that mal-operation is practically impossible, both during start-up and normal running.

The main reason for such extensive instrumentation is the danger of explosion which must be guarded against during the manufacture of ammonium nitrate. In general, acidic conditions and high temperatures must be avoided. The reactor and separator must, therefore, be kept alkaline by excess ammonia at all times. On the other hand, too high an alkalinity will result in waste of ammonia. The optimum excess of ammonia is found to give a pH of 10 in the condensed steam from the separator. Close control of acid/ammonia ratio is required to maintain the desired pH, and rapid corrective action is necessary because the residence time in the reactor is only 0·1 to 0·2 sec. The capacity of the reactor is made as small as possible so that the minimum amount of ammonium nitrate is held at any time under conditions which might be dangerous.

Referring to Fig. 4, both the gaseous ammonia (FT1, FIC1) and the nitric acid (FT2, FRRC2) flows are controlled, and they are also controlled in ratio, the master controller being FIC1. The flow transmitters are Fischer & Porter variable area type. The receiver controllers are of Foxboro Yoxall manufacture and the control valves are supplied by the Fisher Governor Company, as are all other major controllers and control valves on this plant. Both controllers are fitted with low flow contacts which operate alarms, and also the automatic shut-down, purge, and wash cycles.

The E.I.L. pH recorder-controller regulates a small stream of gaseous ammonia which by-passes the main ammonia flow controller. The ratio setting in FRRC2 is adjusted, when the plant is running, to bring the pH controller into the middle of its control pressure range.

Acid preheat temperature is important because (along with acid concentration) it determines the concentration of the finished ammonium nitrate solution. It is also important because, if too high, it could result in dangerous conditions in the reactor. It is controlled by TRC1, regulating the admission of 200 p.s.i. steam to the acid heater. This instrument is a Sunvic helium-filled temperature transmitter, used in conjunction with a Foxboro Model 40 two-term receiver controller. The bulb is inserted into a stainless steel pocket located in the acid line, adjacent to the reactor.

Reactor temperatures at four levels, together with top and bottom separator temperatures, are recorded on a multi-point temperature recorder which embodies a high temperature contact which functions on all points, operating the shut-down system. Thermocouple wells in the reactor are subjected to severe corrosion and erosion. The thermocouples are iron/constantan

protected by tantalum wells which in turn are shielded from mechanical damage (due to movement of the reactor packing rings) by external stainless steel protection tubes.

There are some interesting features in the control system applied to the ammonia vaporiser. Before start-up, the heat required to vaporise the liquid ammonia must be provided by the 200 p.s.i. steam supply from the boiler house. When the plant is running, this heat is supplied by the low pressure process steam from the separator. At some point during start-up the transition must be made from factory steam to process steam, with the minimum disturbance to the gaseous ammonia pressure. Incidentally, the liquid ammonia supply pressure is about 200 p.s.i. and the pressure in the vaporiser (gaseous ammonia pressure) is required to be controlled at about 100 p.s.i.

In this vaporiser there is no separate start-up steam coil as in the nitric acid plant vaporiser. Start-up steam flows downwards through the same tube-bundle as the process steam, the ammonia being outside the tubes.

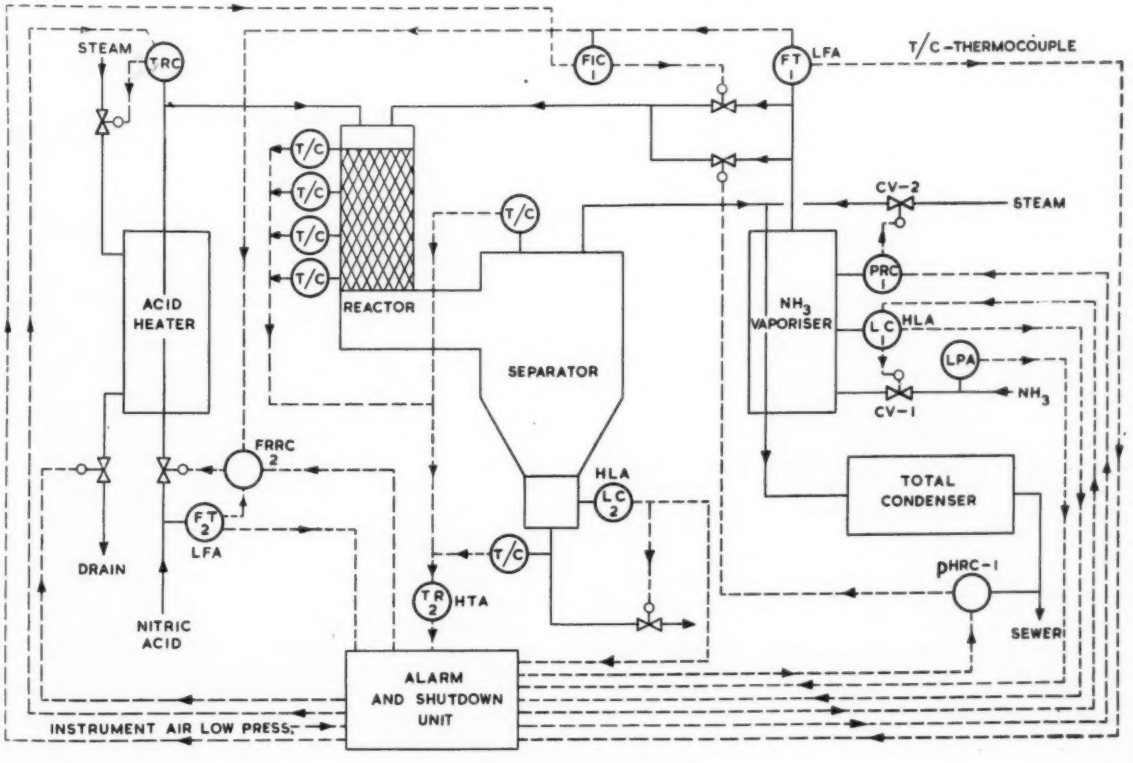
At start-up the level of liquid ammonia in the vaporiser is controlled by LC.1 which regulates the admission of liquid ammonia to the vaporiser through CV.1. Simultaneously the pressure is controlled by PRC.1 which operates CV.2 to regulate the amount of factory steam to the tube bundle. As the start-up proceeds, more and more process steam flows from the separator to the vaporiser. The vaporiser pressure tends to rise and PRC.1 progressively closes CV.2. This control valve is equipped with a limit switch, and when the valve closes completely, a pilot light on the control panel is extinguished. The operator then presses the "Balance" push-button which operates a pneumatic circuit to disconnect PRC.1 from CV.2, leaving CV.2 closed. He can now put PRC.1 on "Manual" and match its control output pressure with that of LC.1. He next presses the "Normal" button which operates another pneumatic circuit to disconnect LC.1 and connect PRC.1 to the liquid ammonia inlet valve CV.1. "Bumpless transfer" of control from LC.1 to PRC.1 is thus achieved. Although the vaporiser is now entirely on pressure control, a high level alarm switch remains in circuit, and this is connected to the shut-down system.

Fig. 5 serves to indicate the manner in which a pneumatic circuit is employed to carry out the operations described above[5].

The pneumatic diverter valves are miniature three-way valves having a small capacity diaphragm chamber. The triangles indicate the diaphragm locations which may be considered in a similar manner to the solenoid coil in an electrical circuit.

The numerals inside the triangle denote the number of the diverter valve and the numeral outside indicates the branch number in which the ports are situated. Likewise the first numeral adjacent to the port symbols

Fig. 4. Flow diagram of ammonium nitrate process showing main instrumentation



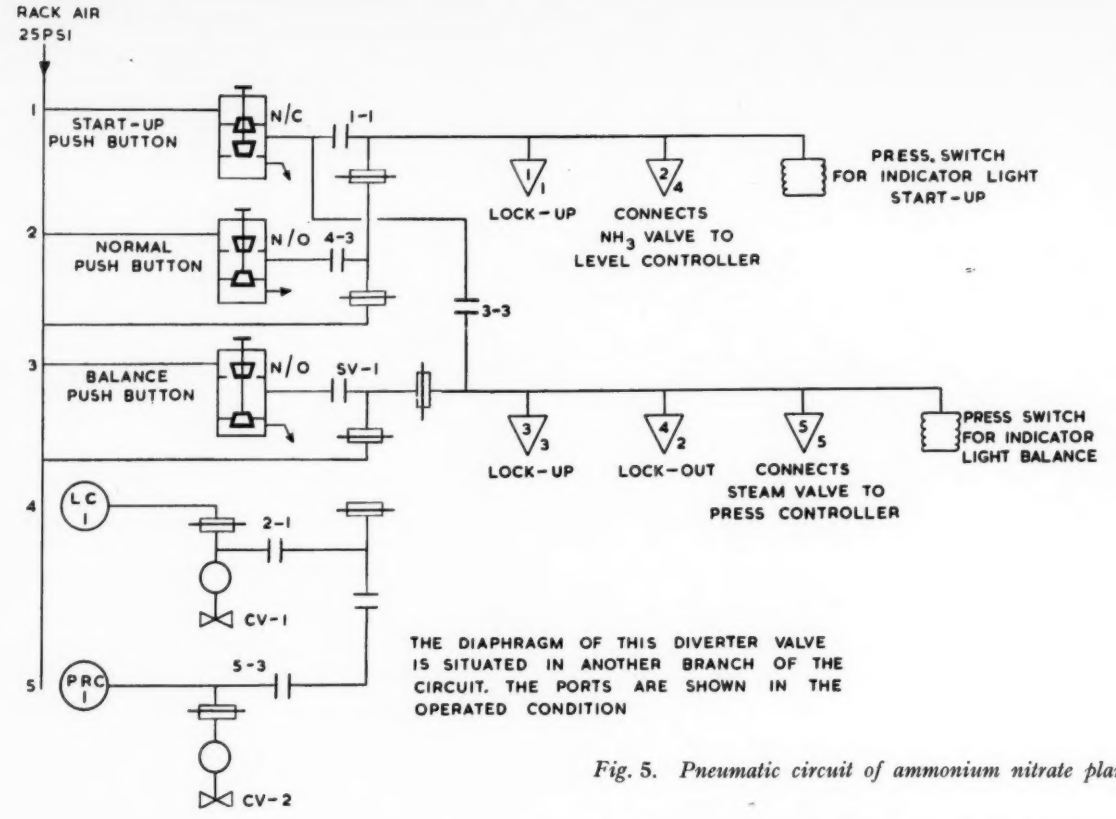
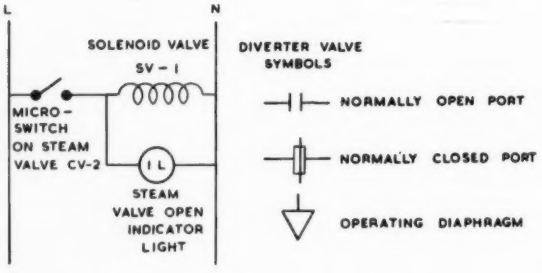


Fig. 5. Pneumatic circuit of ammonium nitrate plant



represents the diverter valve number and the second numeral shows in which branch the diaphragm is inserted.

Operating the Start-up push-button supplies air to both branches 1 and 3. DV-1 changes its ports at the same time as DV-3 and DV-4. Branch 1 is now charged from the air rack via the ports of DV-4 and branch 3 is charged through the normally open Balance push-button and the ports of the solenoid valve SV-1.

The NH_3 level controller LC.1 is connected to its valve CV.1 via diverter valve 2, and the start-up steam valve CV.2 is connected to the pressure controller PRC.1 via the diverter valve 5.

When the start-up steam valve opens the micro-switch fitted to the valve stem will operate the solenoid SV-1 and then branch 3 will be maintained in a charged condition by direct connection to the air rack.

Thus it will be seen that it is not possible to disconnect the steam valve from its controller whilst the valve is open.

When the NH_3 pressure in the vaporiser is sufficiently high to close the steam valve, SV-1 will release and the pilot light extinguish. The Balance button can now be operated to discharge branch 3 and disconnect the steam valve from the controller. The branch is completely discharged via the ports of DV-3 and the Start-up push-button.

When branch 3 is released it is then possible to operate the Normal push-button which will discharge branch 1 and disconnect the level controller from its valve. In this condition, on the actual plant, the pressure controller PRC.1 is automatically connected to the NH_3 control valve CV.1 through a branch which includes the ports of a diverter valve whose diaphragm is in another part of the circuit, not shown in Fig. 5.

The diverter valves are modified Foxboro seal valves, and the Start-up, Normal, and Balance push-buttons are Martonair Type 256-B/1 with Foxboro button guards.

Space will not permit a detailed description of the remainder of the extensive electro-pneumatic interlock system employed on this plant. It is, however, similar in principle to the vaporiser circuit, which therefore serves as an example of the method employed.

Regarding the rest of the system, it must suffice here to state its main function which is to effect the shut-down, purge, and wash cycle sequences, either on

manual initiation, or automatically when any of the following conditions arise:

1. Reactor temperature too high
2. Low flow of gaseous ammonia
3. Low pressure of liquid ammonia
4. High level of ammonia in vaporiser
5. Low flow of nitric acid
6. Low pressure, instrument air
7. Power failure.

When the shut-down sequence is started, either by manual or automatic signal, the following operations are carried out automatically:

1. pH control valve is closed (gaseous ammonia flow in by-pass stops)
2. Acid supply valve to nitric acid pumps is closed
3. Steam CV to acid heater is closed
4. Steam space of acid heater is vented, to stop heating as quickly as possible
5. Acid flow CV is set to a predetermined opening. Note acid flow has already ceased because of Step 2
6. Clean water CV is opened in suction line to nitric acid pumps. A pre-set wash water flow starts to the reactor and separator because of Step 5
7. Liquid ammonia CV to vaporiser is closed
8. Gaseous ammonia to reactor CV is closed slowly after allowing a purge flow of ammonia to the reactor and separator, thus preventing any possibility that traces of nitric acid might remain in the plant
9. The wash water flow is stopped after a timed interval.

Thus dangerous conditions are not allowed to arise during shut-down and the plant is left in a safe and clean condition.

Acknowledgements

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MICROVOLT CALIBRATION CONSOLE

Summary

A microvolt calibration console for the rapid, accurate measurement of low-level r.f. outputs in the microvolt ranges has been developed by the National Bureau of Standards. It covers a range from 1 to 100,000 microvolts at 10 frequencies between 30 kc and 400 Mc. Overall accuracy of measurement is 2 to 5% depending on the frequency.

A MICROVOLT calibration console developed by the National Bureau of Standards for its Electronic Calibration Centre at Boulder, Colorado, provides a rapid, accurate means for calibrating signal generators that have low-level r.f. outputs. The console covers a range from 1 to 100,000 microvolts at 10 frequencies from 30 kc to 400 Mc. Overall accuracy of measurement is 2 to 5 per cent depending on the frequency. The microvolt calibration console provides the Bureau with an additional calibration facility to help meet the continually expanding needs of Government and industry for electronic standards and calibration services.

A signal generator can be calibrated on this console in about one-half the time previously required using r.f. micropotentiometers, and in about one-fifth the time needed by more cumbersome methods. The improvement in efficiency is a result of grouping in a single installation all of the components necessary for calibrating a signal generator, with simple controls to connect the appropriate frequency sources and reference standards to the equipment under test. For convenience, r.f. power is furnished from r.f. voltmeter calibration consoles located in another part of the Electronic Calibration Centre. The system could, however, be made completely self-contained by adding r.f. sources to the console itself. The reference standards used are carefully calibrated r.f. micropotentiometers.

Each r.f. source is crystal controlled, has harmonics suppressed 60 db or more, and voltage output stability of 0·1 per cent over a period of 15 to 20 minutes. By remote control, the operator at the microvolt console can turn on any one of the r.f. sources that is not in use for other calibrations. At the same time, the r.f. power output from the source is automatically switched from the internal load of the voltmeter console to an external rigid coaxial line which transmits the energy

to the microvolt console. A servo-motor control adjusts the level of the r.f. power.

To calibrate a signal generator, an r.f. source of the appropriate frequency and the corresponding receiver are selected with a frequency selector switch. Before r.f. power is applied to the console, a reference standard with an output voltage required for a given calibration range is connected to the r.f. source circuit. The servo-motor control is then adjusted to bring the r.f. voltage output of the reference standard approximately to the desired working level. With the generator under calibration tuned to the same frequency as the r.f. source, and with its output adjusted to the level to be calibrated, the receiver is connected alternately to the signal generator and to the secondary standard, and the output of the latter is then adjusted until the receiver indicates that both r.f. levels are equal. The d.c. millivolt output indication of the reference standard is noted, the r.f. power is removed and, for best accuracy, the thermocouple of the reference standard is calibrated with a built-in direct current source. The actual r.f. voltage output of the micropotentiometer, and hence of the signal generator, can then be calculated since the d.c. resistance and the d.c.-to-r.f. characteristics of the r.f. micropotentiometer resistance elements are known.

Supplementary Information

To obtain a wide range of voltage values, twelve r.f. micropotentiometers with overlapping ranges are used as secondary standards. With this number of units, each standard can be intercompared with those covering adjacent voltage ranges. A coaxial switch on the front of the console connects the r.f. power to any one of the standards and simultaneously connects the indicating d.c. millivoltmeter to the thermocouple output of the r.f. micropotentiometer in use. An impedance in series with each r.f. micropotentiometer improves the impedance match to the r.f. source and prevents overload damage by limiting the r.f. power supplied to the standard.

For frequencies of 30 Mc/s and below, independent crystal-controlled receivers are used as detectors for comparing the magnitude of the "unknown" voltage against the standardised voltage of the r.f. micropotentiometer. At the higher frequencies, converters with crystal-controlled oscillators are used with a single 30 Mc/s receiver.

The frequency selector switch, which selects the proper r.f. source, also connects the appropriate receiver to a differential voltmeter. A step attenuator is permanently connected to the receiver input to reduce large signals to a working level that does not saturate the receiver. Matching networks or additional external pads may be connected to the input of the flexible coaxial cable of the receiver, to insure that the impedance loading the signal generator under calibration is accurately known. A stable, accurately measured source of direct current is also incorporated in the console for calibrating the thermocouples of secondary standards or of r.f. micropotentiometers submitted for test.

To calibrate an "unknown" r.f. micropotentiometer, it is connected to a second section of the console provided for this purpose. R.f. power, supplied from the same source as above, is gradually increased to a desired level of the "unkown". The r.f. level of the standard is then adjusted until the receiver indicates equal output from each. With the r.f. power disconnected, the thermocouples in both the "unknown" and the standard are calibrated with the internal d.c. source; the r.f. voltage is then calculated.

B.S.I. Amends Standard for Symbols, Signs and Abbreviations

THERE is a vital need for a standard notation in which physicists, chemists, engineers and other technologists can express their ideas. Six years ago the British Standards Institution took a major step towards meeting that need when it published B.S.1991, **Letter symbols, signs and abbreviations.**

Part 1: **General**

It has now been decided to make a comprehensive revision of Part 1 to reflect the considerable progress that has been achieved, nationally and internationally, during recent years. But meanwhile, having in mind the issue early in 1961 of 4 further parts to the standard*, B.S.I. has issued an amendment to Part 1 (obtainable as PD3920). It brings into effect the more important modifications which are necessary to avoid inconsistency between the various parts. Copies of this amendment are available free of charge from the B.S.I. to all those holding copies of B.S.1991.

The following points of particular interest will be found among the revisions made in the amendment:

1. In order to distinguish between the pound as a unit of mass and the weight of a pound under standard gravity as a unit of force, distinctive abbreviations are recommended for these two units, i.e., "lb" for pound mass and "lbf" for pound-force; likewise, "kg" for kilogramme mass and "kgf" for kilogramme-force, etc.
   The use of the letter "f" for this purpose follows a decision of the International Organisation for Standardisation and replaces earlier methods of making a distinction.
2. It has been decided to maintain more rigorously than hitherto the general principle that symbolic abbreviations for units should not carry a full-stop as part of an abbreviation. This principle has been observed for many years by international standardising bodies but there have been a few exceptions in B.S.1991: Part 1. In future all the abbreviations for metric and British units in B.S.1991 will follow this principle. For example, the recommended abbreviations for horsepower and British thermal unit should be written "hp" and "Btu", without full-stops.

*—The titles of the new parts will be: Part 1: Chemical engineering, nuclear science and applied chemistry; Part 2: Fluid mechanics; Part 3: Structures, materials and soil mechanics; Part 4: Heat engines.

REVIEW OF COUNTING EQUIPMENT

at the

Institute of Physics and Physical Society Exhibition

THIS year has brought the 45th Annual Exhibition of what used to be the Physical Society and is now the Institute of Physics and the Physical Society as a result of amalgamation of the two bodies. The conditions of the exhibition demand that apparatus displayed must be new since last year's exhibition, though "new" in this sense may very well mean an improvement or a modification to an instrument.

In view of the relatively short period of seven months since the I.E.A. Exhibition, large numbers of completely fresh developments could not be expected at the Physical Society Exhibition nor has there been any startling new trends. Trends visible at the I.E.A. Exhibition have been maintained and developed, but in view of the lack of fresh trends it has been decided to concentrate this review on the very important field of counting instruments.

High Speed Counting

Marconi Instruments Ltd. showed a high-speed counter timer with built-in frequency standard, the TF1345 10 Mc/s electronic counter. This instrument may be used as a frequency meter for the measurement of transmitter and oscillator frequencies, pulse repetition rates, mechanical vibration frequencies, and revolutions per second. The outputs derived from the internal standard are also available for such purposes as setting up wavemeters or receivers. The instrument may also be used as a decade frequency divider up to a factor of 10^8.

A direct count of impulses arriving at regular or irregular intervals can be made at any speed up to 10^7 per second. The input signal may be in the form of sinewaves or pulses.

For frequency measurement, the number of cycles occurring in a gate period is counted and indicated on the display in terms of kc/s. There are five switch-selected gate times: 0·001, 0·01, 0·1, 1.

The TF1345 is an 8-decade counter with a readout in the form of columns of neon-indicated numbers. Lighting of the appropriate one of five subsidiary neons indicates the position of the decimal point when the instrument is used for time or frequency measurements.

The display time is continuously variable between 0·1 and 10 sec, and can be held indefinitely by manual control. It must be greater than the gate time. The count is automatically reset at the end of the display period and the action is repetitive.

Provision is made for using an external frequency standard when measurements of very high accuracy are required.

Measurement of low frequencies by the above method may not be sufficiently accurate in a 10-second gate period. Provision is therefore made for extending the gate and display period, by means of a manual control, to any integral multiple of 10 seconds. This facility is also useful when measuring high frequencies very accurately with an external standard source.

Time measurements are similar to period measurements. Start and stop impulses marking the beginning and end of the interval being measured are applied to the counter. These pulses operate the gate and a direct count is made of the number of cycles of the appropriate internally generated standard frequency.

The accuracy of frequency measurement is ± 1 count $\pm$ standard-frequency accuracy. The accuracy of waveform period measurement is $\pm 0{\cdot}2\%$ (single period), $\pm 0{\cdot}02\%$ (average of 10 periods).

The stability of the standard frequencies is ±2 parts in 10^7 short term, and ±2 parts in 10^6 per week. For higher accuracies the instrument may be operated from an external 100 kc/s standard source.

The transistorised high-speed counter, Type 298, shown by Airmec Ltd., can be used to measure frequencies up to 50 Mc/s and time intervals from 1 microsecond to 10^8 sec.

The indicator consists of a large, eight-figure in-line display unit on which both the units of measurement and the decimal point are shown. The display time is $\frac{1}{2}$ to 10 seconds, or infinite. The count is continued when necessary on a 5-digit resettable printer to be operated from the counter in order that permanent records of the readings may be obtained.

The principle of operation for time measurement is that of counting the number of cycles of a standard oscillator occurring during the measured period. For frequency measurement, the standard oscillator gates the input signal for a controlled period, during which the cycles of the input signal are counted. A standard oscillator with a short term stability of 1 part in 10^7 is incorporated, but for greater accuracy an external standard may be used.

Counter Data

Time Units:	
(for period and time measurement)	0·1, 1·0, 10, and 100 μs
Gate Time:	
(for frequency measurement)	1, 10, and 100 ms 1, 10, and 100 seconds
Accuracy:	±1 count ± oscillator stability
Oscillator Stability:	±1 part in 10^7 short term ±5 parts in 10^7 long term.

The transistorised counter shown by Advance Components is designed for the measurement of frequency, period and time. The frequency range is from 10 c/s to 10 Mc/s via the input amplifier, or from zero to 10 c/s via the v.l.f. input. Time measurement is possible from 0·5 microseconds using selected time units in decade steps from 10^{-7} to 10 seconds. The range of period measurement is from 1/10 second to 10^7 seconds.

In-line projection indicators provide a display of seven figure numbers and an eighth indicator is provided to show a caption of which units of measurement are being used. A decimal point moves to the correct place under the control of the function switches so that a non-arbitrary reading is effected. The display time is variable between 1 and 5 seconds or may be held manually indefinitely.

The internal standard reference frequency is derived from a temperature controlled 10 Mc/s crystal oscillator, which also provides, through frequency dividers, output timing pulses at any one of nine standard repetition frequencies. Self-checking facilities are built in to test the operation of both counter chains.

Counter Data

Accuracy:	Counting accuracy is ±1 count, the accuracy of time or frequency measurement is ±1 count ± internal or external standard accuracy.
Internal Standard:	10 Mc/s crystal ± 1 part in 10^7 at +25°C. Decade divisions down to 0·1 c/s.
External Standard:	B.N.C. socket and switch provided for use of external standards at frequencies up to 1 Mc/s.

Rank Cintel also showed a 10 Mc/s counter timer. This is similar to their 1 Mc/s counter timer described under "Normal Counting".

Basically it comprises a counting chain consisting of a 5 Mc/s crystal oscillator (multiplied to 10 Mc/s for use in the chronometer), gate and seven decades in cascade. Results of measurements are displayed on seven panel mounted meters each scaled from 0 to 9.

With one line working the time range is 0·3 μ sec to 1 sec in 1 μ sec steps. With two lines working the time range is 0·1 μ sec to 10^6 sec in 8 decimal ranges.

The accuracy in both cases is ± 1 part in 10^7 ± 1 digit.

When the instrument is used for measuring events/unit time the range is 10 c/s to >10 Mc/s or 0 to ⩾ 7 Mc/s for pulses. The accuracy is ±1 part in 10^7 ±1 digit using the internal time standard.

Normal Counting

The Rank Cintel universal 1 Mc/s counter has readout facilities for operating a printer or any other required indicating system. The complete instrument comprises a number of Cintel standard printed circuit panels arranged to form a counting chain and a time interval generator chain.

The results of all measurements are indicated in decimal notation on six meters each scaled from 0 to 9.

The instrument can be used to measure the time interval between two occurrences at a given level in a continuously varying electrical function, or the time interval between any event the beginning and end of which is defined by two separate positive or negative group pulses in any combination.

A 1 Mc/s oven-controlled crystal oscillator feeds via an emitter follower stage to a gate unit. The gate is operated in response to positive or negative going start and stop pulses in any combination as selected by a switch.

Counter Data

Time Range:	1 μs to 1 sec in steps of 1 μs
Accuracy:	±2 parts in 10^6 ± 1 μs
Frequency Range:	10 c/s to 1 Mc/s
Accuracy:	±2 parts in 10^6 ±10^{-3}, 10^{-2}, 10^{-1}, 1 or 10 c/s depending on measuring period.

J. Langham Thompson showed two new additions to their range of counting equipment. These are a high frequency counter, Model 6010, intended mainly for laboratory use with a seven digit readout and operating up to 1 Mc/s, and a low frequency counter, Model 6018, which has four digit readout, operates up to 30 kc/s and is intended mainly for industrial work.

Both instruments have facilities for:

1. Measurement of frequency or r.p.m.

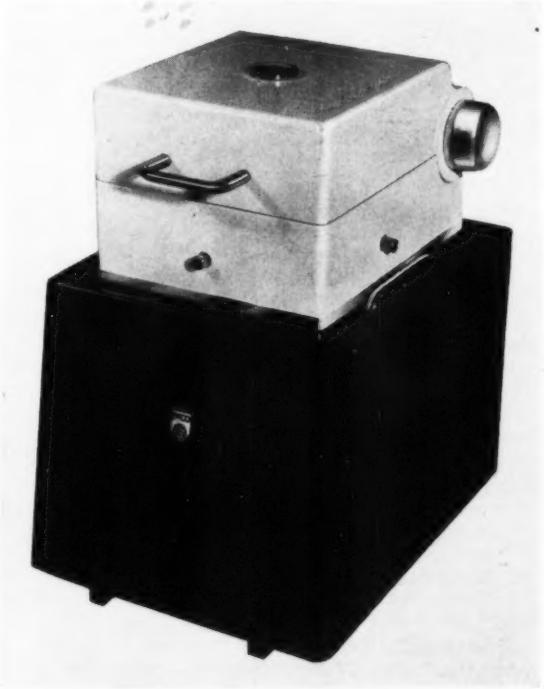
2. Measurement of the time interval between two positive-going pulses or the period of one cycle of a repetitive waveform
3. Gated counting
4. Comprehensive self-checking on all ranges.

In the Model 6010 the 1 Mc/s crystal oscillator is enclosed in a thermostatically-controlled oven to ensure a stability of 1 part in 10^7 per week. The Model 6018 employs a 1 kc/s crystal oscillator with an accuracy of 5 parts in 10^4.

Counter Data

	Model 6010	*Model* 6018
Frequency Measurement:		
Frequency Range:	10 c/s to 1 Mc/s*	10 c/s to 30 kc/s
Gate Times:	0·1, 1 and 10 sec	0·1, 1 and 10 sec
Accuracy:	±1 count ±standard frequency accuracy.	±1 count ±standard frequency accuracy.
Time Measurement		
Form of measurement is the interval between two positive-going pulses or period of one cycle.		
	Model 6010	*Model* 6018
Maximum Frequency:	100 kc/s	1 kc/s
Time Range:	10 μs to 10,000 sec (10^6 sec using standard output frequencies).	1 ms to 1,000 sec (10^4 sec using standard output frequencies).
Accuracy:	±1 time unit ± standard frequency accuracy.	

*—With increased signal input, pulse widths down to 100 m μs can be counted.



Scintillation Counters

The β-probe, Type BP 4, shown by E.M.I. Electronics, is a scintillation counter intended primarily for the detection of low energy β radiation. Its advantage over mica-end window Geiger counters is that it does not saturate at high count rates. The phosphor used is anthracene with an area of 16 cm².

The window area is 20 cm² and the thickness of the aluminised Malinex window is approximately 1·5 mg/cm². The overall detection efficiency for carbon 14 is 15%.

The Ekco Electronics scintillation counter, Type N664, is a shielded, bench-standing instrument for counting millimicrocurie quantities of β and γ emitters.

β emitters, including tritium and carbon 14, are counted by liquid scintillation counting and gamma-emitters are counted by using NaI(TI) crystals.

The sample chamber is shielded in all directions by 2·5 cm of lead. For liquid scintillation counting the radioactive sample is either dissolved in a liquid phosphor, or suspended in a gel.

The efficiency is given in the following table:

Background	Efficiency
2 to 3 counts/sec	40 to 50%
24 counts/sec	24%
13 counts/sec	10%
18 counts/sec	50%
7·5 counts/sec	30%
5 counts/sec	20%

Depending on how the radioactive sample is prepared, well counting, annular counting or "end-on" counting may be used for γ emitters. The performance for each method is given below.

	Well Crystal Method (5 ml)	Annular Sample Method (10 ml)	"End-on" Method (20 ml)
Background Count	550 c.p.m.	78 c.p.m.	300 c.p.m.
Sample Count	6,600 c.p.m.	2,250 c.p.m.	4,600 c.p.m.
Total Count	7,150 c.p.m.	2,328 c.p.m.	4,900 c.p.m.

The universal scintillation head, Type 214A, shown by Ericsson Telephones, is designed for the detection of alpha, beta, gamma, or X-radiations, and fast or slow neutrons. The unit is fitted with a 20th Century 11/23 eleven-stage photo-multiplier tube, and is supplied with separate phosphors for alpha, beta and gamma detection.

Fig. 1. *Ekco Type* N664 *universal scintillation counter*

Using a plastic phosphor 1 inch in diameter and 2 inches long, a tube voltage of 1,300 volts, and a radium source, a typical sensitivity is 10^4 counts per minute per mR/h. The background count under these conditions is approximately 200 counts per minute at room temperature (20°C).

Proportional Counters

20th Century Electronics have developed a proportional counter, PX130, for X-ray fluorescence analysis. One application is the measurement of plating thickness by measurement of the intensities of the fluorescent X-radiation produced by the primary X-radiation incident upon the plated surface.

The PX130 is a 2 in. diameter proportional counter constructed of aluminium with a beryllium window 23 mm in diameter and 0·5 mm in thickness.

The counters are available filled with mixtures of argon-methane or xenon-methane.

As an example of the energy resolution achieved with these detectors 10·5 keV X-rays can be measured with an energy resolution of 9% whilst for 5 keV X-rays a resolution of 17% can be achieved.

The proportional counter should be operated into a linear pulse amplifier with a bandwidth of at least 2 megacycles and a minimum overall gain of 10^6 (including head amplifier).

Suitable amplifier time constants are integrating and differentiation time constant of 1·6 μ sec.

The company also showed an X-ray proportional counter for the energy range 20 to 100 keV. This counter, Type PX115, is useful in interpreting the complex spectra that occur in radioactivation analysis. The recommendations for the pulse amplifier and amplifier time constants are the same as for the Type PX130.

A proportional counter for X-ray micro-analysis was shown by Cambridge Instruments Ltd. It is used for detecting the hard radiation from elements with the higher atomic numbers within the range of the Cambridge Microscan, and is interchangeable with a flow counter for soft radiations.

The counter consists of a cylindrical 1 in. diameter gas-filled ionisation chamber with a central wire electrode 0·002 in. diameter fixed to each end by an insulating glass-to-metal seal.

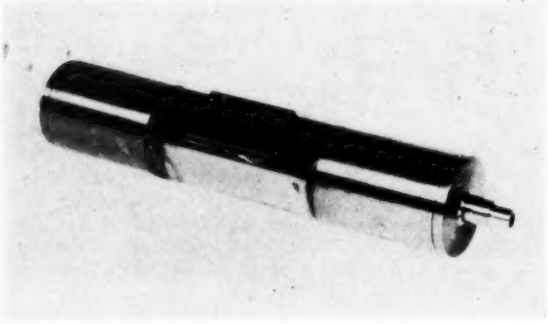


Fig. 2. Proportional counter for Cambridge Microscan X-ray analyser (sealed type)

X-rays enter the side of the cylinder through a beryllium window 0·005 in. thick and cause ionisation of the gas. If the electrode is at a suitable potential with respect to the cylinder, this ionisation is discharged and the electrons, diffusing to the central electrode, cause multiplication and produce a pulse. At a given potential the magnitude of this depends on the number of electrons (i.e., the number of ion pairs) formed by the X-ray quantum, and is, therefore, a measure of the quantum's energy or wavelength. Varying the potential of the wire electrode controls the multiplication and hence the pulse height.

For the counter to function efficiently at the shorter wavelengths, the proportion of X-ray quanta absorbed in collision with the gas over the radius of the counter must be high. For this reason a heavy gas is needed and xenon is used with a small amount of ethyl formate added to stabilise the gas multiplication.

The counter works within the range 1,000 to 2,000 volts.

Coincidence Counting

The coincidence tritium counter shown by Ericsson Telephones counts low energy β particles emitted by tritium. A known volume of tritium is dissolved in alcohol or toluene and added to a suitable liquid phosphor. This solution is then poured into a sample cell positioned between two diametrically opposed photomultiplier tubes. Scintillations resulting from β particles are thus seen by both photomultiplier tubes simultaneously. The resultant pulses, when fed to the coincidence unit, are accepted and result in a corresponding output pulse which drives a scaling unit. Random noise pulses produced in the system are rejected by the coincidence unit and are not registered.

It is therefore possible to discriminate between pulses derived from (a) the sample and (b) the thermal noise generated within the photomultiplier.

Counter Data

Maximum Counting Rate:	250 kc/s
Resolution Time:	4 μs
Counting Efficiency:	10% to 40% depending on cell and type of phosphor used.

Isotope Developments have designed equipment for measuring millimicrocuries of low energy β-emitting isotopes. A glass cell contains the sample to be measured which is mixed with a liquid scintillator. There is a shutter mechanism so that samples may be changed in full daylight. Facilities are provided to introduce a cooling liquid for high ambient temperature use but under normal conditions no external cooling is required. The two 14-stage photomultiplier tubes are motor-driven to bring them into contact with the face of the glass cell. The signal output from the two cells is taken via two non-overloading amplifiers and a pulse height analyser to a fast coincidence unit, in order to cancel out the thermal noise from the photomultiplier tubes.

The resultant background count is of the order of 1 count per second and with millimicrocuries of tritriated water an efficiency of 10% is obtained.

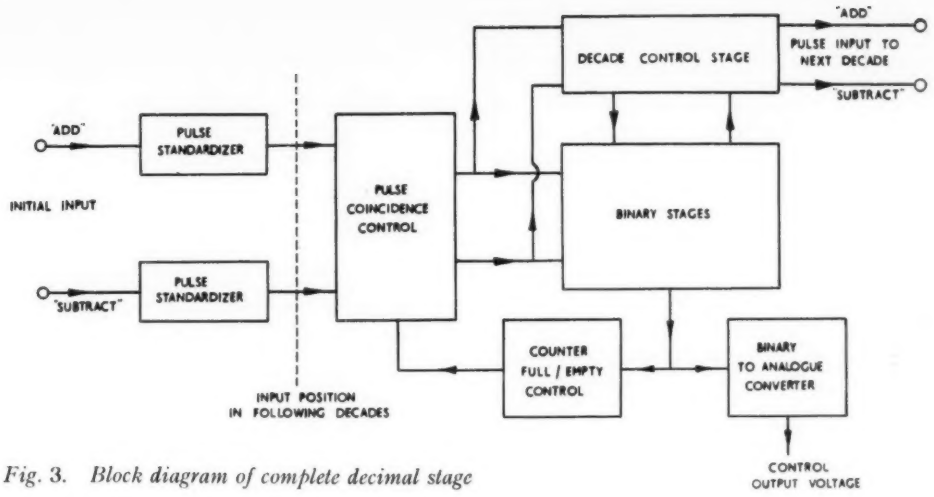


Fig. 3. Block diagram of complete decimal stage

Bi-directional Random Input Counter

The counter, a complete decimal stage of which is illustrated in Fig. 3, uses commercial binary units with delay times of 2 microseconds each. All 20 units in a 5-decimal digit counter can be switched and an output pulse produced in 2 microseconds. Normally 20 microseconds are required.

The circuits can be set to add or subtract pulses occurring on two separate input lines regardless of possible overlap of the pulses. Each pulse input can have a maximum frequency of one third of the maximum counting frequency of the binary stages employed. Pulses occurring within the resolution time of the binary units are detected in the non-critical circuits shown in Fig. 4, and replaced by adequately spaced pulses when adding, or suppressed when subtracting. Each pulse is directed via gates, depending on the state of the counter when the pulse arrives.

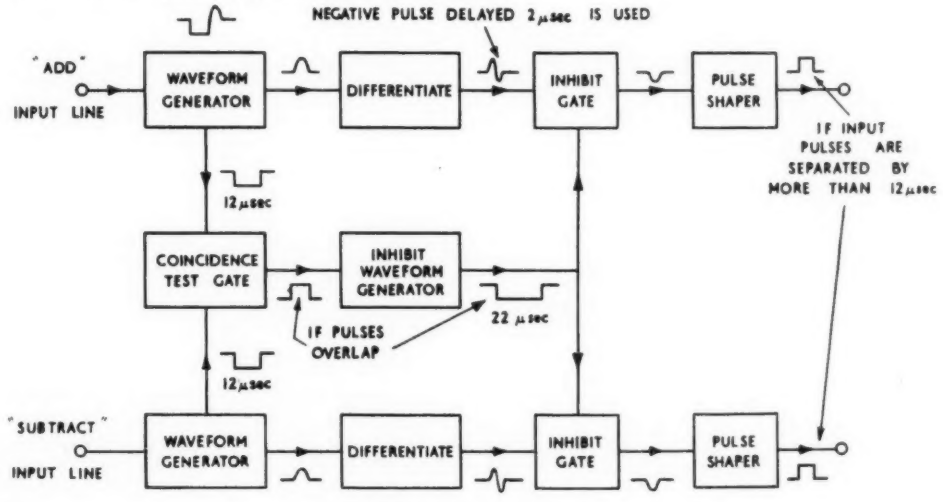
The instrument was developed at the National Engineering Laboratory to compare two pulse trains for shaft speed control, and for the measurement and correction of errors in gears.

Computing Counter Controller

Racal Instruments showed a fully-transistorised universal counter timer utilising ferrite core techniques. The instrument incorporates a fully variable digital time base and an in-line nodistron display.

Frequencies up to 110 kc/s can be measured with an accuracy of ± 1 count $\pm 0{\cdot}005\%$. Time interval measurement can be up to 27·8 hours. The counter controller may also be used for period measurement, as

Fig. 4. Block diagram of pulse coincidence control



a frequency divider and as a clock pulse source. Digital outputs are available from each indicator in the form of relay contact closures for the operation of an external read-out or digital printer.

Gated Dekatron Counter Units

When the diffractions in X-ray powder diffraction patterns are very weak it is usual to measure the intensity at a series of fixed detector positions so that any degree of resolution and statistical accuracy can be achieved by having slits suitably small, and counting periods sufficiently long to achieve the desired accuracy.

To do this a gated counter unit is connected to the ratemeter which receives the output from the detector so that the number of individual counts arriving in a predetermined time is recorded, or, more conveniently, the time is recorded for a certain number of counts. This latter method has the advantage of giving each observation the same statistical accuracy. Whichever method is employed, a time-measuring device must be used which can be mechanically or electrically coupled in such a way that the termination of counts stops the timer or *vice versa*.

A gated counter unit has been developed by Solus Schall Ltd. to perform all the functions necessary in X-ray diffraction work of this kind. Each unit will serve as either a counter or a clock. The unit is composed of a pulse gate which will receive signal pulses of either sign, can be opened or shut manually or by control pulses, and also gives out control pulses from other terminals when the gate opens or shuts. The signal pulses, after being allowed past the gate, enter a four-digit dekatron counter whose first stage employs a faster dekatron capable of counting regular pulses at 25 kc/s. By turning a selector switch the unit provides a control pulse after (1, 4, 6, 10) $\times$ (10, 10^2, 10^3, 10^4) signal pulses have arrived which can be used to control itself and other units.

For all operations, other than the simplest one of timing or counting, two of these identical units will be required so that one acts as the counter and one as a timer using its own 100 c/s signal derived from the mains. If frequency drifts of mains occur which are greater than the required accuracy demands, then an external sine-wave oscillator may be used. By suitable interconnections from the front panel either of the two principal counting methods can be employed.

The diffraction procedure is to "inch" the detector of the goniometer by increments of the same order as the slit-width, this latter being chosen to ensure that sufficient resolution is achieved for the purpose in hand. The reciprocal of the time required in each position to receive 10,000 pulses will give each reading with a deviation of $\pm 1\%$. Greater accuracy can be achieved by this means than with the continuous recording technique. Areas of the diffraction diagram obtained from the recorder in a normal run can be investigated in detail for small amounts of trace elements, etc.

A further application of these units is to use them as separate signal and monitor chains in cases where the stability of X-ray output is not assured. Inching the detector is again performed and the signal chain is automatically switched off after a predetermined number of counts has been received from the monitor.

Counter Data

Required pulse size to count:	30 V $\pm$ve; width 2 μs 1·5 V $\pm$ve; width 5 μs 1·0 V $\pm$ve; width 1 ms
Output pulse when count completed:	80 V — ve; width 100 μs
Maximum regular pulse rate:	20,000 p.p.s.

BOOK REVIEWS

Self-organising Systems. *Edited by Marshall C. Yovits, and Scott Cameron. Symposium Publications Division of the Pergamon Press.* 1960. 330 *pp.* 60s. 0*d.*

Intriguing possibilities seem to exist for the design of new components, instruments and instrumentation systems, judging by the aims postulated at a conference sponsored by the U.S. Office of Naval Research and by The Armour Research Foundation. The proceedings of the conference were issued as volume two of "International Tracts in Computer Science and Technology" under the title "Self-organising Systems".

What form an engineered self-organising system will have, or should have, is still a matter of conjecture; perhaps a complex assembly of tomorrow's electronics, perhaps even more. There is, however, a definite similarity between industrial automation and the mechanisation of thought processes, the latter being a more advanced form of automation, so that the solution of the problems involved may not be so far away after all. Information processing is rapidly advancing beyond the stage represented by a computer with a fixed programme and it is expected that machines will be capable of learning from past mistakes and to organise themselves. Machines of that description will be needed for the tackling of problems of automatic print reading, speech recognition, pattern recognition, automatic language translation, information retrieval and of large and complex control systems.

To achieve this engineers will have to enlist the help, knowledge, experience and vision of the psychologists, biologists, and others.

The book records in full 15 papers and as many discussions. The latter were, in some cases, animated and heated—which is not really surprising, considering that representatives from so many various fields of research have taken part and that some of the ideas discussed are still in the embryo stage.

To all those who are at present working on advanced computing systems, instrumentation, and automation, and are interested in the possible application of machines to the solving of problems which were so far the prerogatives of human organisers (i.e., of self-organising

systems of a human nature) this book is sincerely recommended.

L. A. STEINER

Recommended Instrumentation of Small Boilers. *British Industrial Measuring and Control Apparatus Manufacturers' Association.* 22 *pp.* 1960. 2*s.* 0*d. post free.*

Some four years ago, the British Industrial Measuring and Control Apparatus Manufacturers' Association (BIMCAM) issued a handbook entitled "Applications of Instrumentation and Automatic Control". The present brochure of 22 pages, "Recommended Instrumentation of Small Boilers", is intended as a companion. It has been prepared by a joint committee set up by BIMCAM, the National Industrial Fuel Efficiency Service (NIFES) and the Central Electricity Board (CEA). The recommendations are intended to apply to low pressure water boilers with ratings over 500,000 B.T.U./hr and steam boilers with ratings up to 60,000 lbs/hr.

The brochure commences with a consideration of boiler efficiency, explaining why certain measurements must be made. A table then follows listing the measurements specified under the headings: Fuel, Water, Steam and Flue Gas and Air. In each case the minimum instrumentation is given together with recommended extras. Each measurement is then given further consideration and this includes the particular types of instruments recommended and line diagrams showing the selection and siting of the instruments. In the case of steam boilers, the data is usefully divided into that for boilers delivering less than 4,000 lbs of steam per hour, boilers delivering 4,000 to 8,000 lbs/hr, boilers delivering 8,000 to 20,000 lbs/hr and boilers delivering 20,000 to 60,000 lbs/hr.

The address of BIMCAM is 9 Argyle Street, London, W. 1.

Induction-type Intergrating Meters. *By G. F. Shotter and G. F. Tagg. Sir Isaac Pitman Ltd.* 1960. 214 *pp.* 63*s.* 0*d.*

BOTH authors are authorities in their own fields, having long studied the particular aspects of meter design and practice on which they write and much of the book describes joint research in the experimental and mathematical investigation of specific meter problems. Text-books with this general title are largely descriptive of commercial practice, but here commercial models are in the main ignored. Four well-known text-books on meters are quoted for reference. It must be emphasised that this is not an ordinary text-book for students and a reader preferably requires prior knowledge of meters. It is rather two correlated monographs dealing in great detail with certain points. Although the early part, on meter theory, has very general application including to students, the majority of the book is of most use to meter designers, with later parts of application to users.

Following a very brief introductory chapter which is descriptive, a discussion arises on the basic theory of the meter and experimental work is detailed by which the authors show that the common rotating- or sliding field theory is untenable and that the correct theory is the transformer or eddy-current one. A chapter is devoted to detailed experimental and theoretical work on the various parasitic or stray forces acting on the moving system, all of which produce uneven motion and so additional wear at the lower bearing, especially at low loads. Two chapters, which together form a considerable portion of the book, deal with the life-maintaining lower bearing—the steel pivot and synthetic sapphire combination now practically universal in meter construction. Meter Oil No. 2 is recommended here.

The first author (G.F.S.) has been particularly associated with this work for many years and is the foremost authority on the subject. His findings, therefore, have considerable weight; some of the work has been published in E.R.A. Reports and Institution papers and further work is in hand.

The two final chapters are practical and have application to all meter users: they deal with the protection of jewels and pivots from shock damage, and the cleaning and polishing for routine use. Approved portable carriers are described which minimise damage and ensure carriage in an upright position.

The book is well produced and illustrated with many original line drawings. About the only criticism that can be levelled is that the title is somewhat misleading. But it is difficult to suggest a more suitable title, other than adding an outsize sub-title to indicate that it deals firstly with the theory in more detail than any other book, and then with the practical side of bearing design more than can be found elsewhere.

E. H. W. BANNER

B.C.A.C. Reorganisation

FORMERLY the B.C.A.C. operated as a federation of three separate groups concerned respectively with the engineering application of automation, automatic control and computation, and sociological and economic aspects.

These groups have now been merged into a single B.C.A.C. Council.

The B.C.A.C. has decided to set up three panels to activate the following aspects of its work:

Education and Training—Chairman, Prof. G. D. S. MacLellan, M.A., Ph.D., A.M.I.Mech.E. (University of Glasgow).

Research and Development—Chairman, Mr. J. F. Coales, O.B.E., M.A., M.I.E.E. (University of Cambridge).

Public Relations—Chairman, Mr. W. C. F. Hessenberg, M.A. (Deputy Director, B.I.S.R.A.).

Arrangements are in hand for the holding of a conference at Harrogate from 27th to 30th June, with the general title "Automation—Men and Money". Plans are also in hand for the delivery in the autumn of the first annual B.C.A.C. lecture which would be in the form of an authoritative review, by an expert in the field, of the present position and probable future developments of automation procedures in British industry and commerce.

ELECTRICAL TRANSPORT

Instrumentation Helps to Solve Problems

THE BICC Group designs, supplies and installs overhead electrification equipment for British Railways as well as railway modernisation schemes in overseas countries and has naturally, in this field of its activities, a special interest in the mechanical problems peculiar to the operation of such equipment. Foremost among these is that of achieving absolutely uniform current collection from a static overhead wire traversed by a pantograph mounted on a moving train.

The problem arises because the contact pressure between the two components is continually changing. This has been recognised for a long time, but it becomes more important as higher supply voltages and, hence, lighter overhead wires are used, and as running speeds increase.

For information on the performance of his equipment, the designer has hitherto had to rely almost entirely on observations made on the actual railway track but such observations are difficult, lengthy and of limited accuracy. The BICC Group has, therefore, augmented its already extensive research facilities by setting up a new laboratory designed specifically for research of this nature by means of a scale model capable of reproducing faithfully all the dynamic mechanical characteristics of the full-scale equipment at simulated speeds up to at least 100 m.p.h. Believed to be the only one of its kind in the world, this model has been operational for some months in the laboratory at Tolworth, which was visited by the overseas delegates to British Railways Electrification Conference.

The laboratory housing the models measures about 200 feet by 20 feet. The track is in the form of a closed loop with two straight sides 144 feet in length and closing curves 14 feet in diameter. The middle parts of the straight sides, the actual test sections, 80 feet in length, are enclosed and temperature controlled. A trolley, about 12 inches long, driven by a 50-volt d.c. motor supplied with current from the rails, is used as a vehicle for the pantograph and the necessary instrumentation. The motor is underslung to lower the centre of gravity and avoid the risk of derailment at the curves. The scale of velocity is such that an actual train speed of 100 m.p.h. is represented by a model running speed of nearly 18 m.p.h.

The model pantograph follows closely the articulated design of the prototype. Each member was designed with the correctly-scaled bearing length and approximately the correct centre of gravity, but with a lower mass than required. The necessary additional mass was then added by two separate weights which were so positioned that each member possesses the correct centre of gravity and moment of inertia. The two working springs are steel helices and the springing of the pantograph head is achieved with leaf springs.

The three arrangements of overhead equipment—simple catenary, compound and stitched catenary—which have been designed and are being installed by BICC for the British Railways 25 kV a.c. system are being reproduced. The solid contact wire and the standard catenaries are represented by fine wire on which closely spaced cylindrical beads are fixed to give the correctly scaled mass and elasticity.

In all, more than 300 beads are used in each one-foot length of model contact wire so that there was a considerable manufacturing problem. Similarly, the assembly operation was a tedious one requiring a high degree of precision and patience. Every six-foot length was tested for extensibility and flexural rigidity, after which the separate lengths were joined, with a bead covering the joint position so that mechanical uniformity was preserved throughout. The droppers were also manufactured from wire carrying beads or fractions of beads.

The first form of support to be studied is the "hinged cantilever", consisting of a diagonal strut tube supported from porcelain insulators by a stranded tie-wire and hinged at the vertical mast. The upper end of the strut tube holds the main catenary, the auxiliary catenary and contact wire being attached to hinged "registration" and "steady" arms. The latter, which can move independently of all other hinged members, are arranged to be always in tension and are reversed at alternate supports to give the necessary stagger of the contact wire. The inertial mass and distribution of mass are scaled in the model.

Position, velocity and acceleration of the pantograph trolley are essential data which must be known at all times. These are gathered from devices which feed back high frequency signals to a receiver from a transmitter carried underneath the trolley. The transmitter aerial consists of two underslung flat plates spanning a receiver aerial wire carried by the supporting structure.

The movements and displacements of the wires in the model are measured in several ways which may be used separately or in combination; they are either optical or electrical. The optical methods are high speed cinematography, and a method which registers the position of a wire by casting a shadow of it on to a photo-sensitive device. The favoured electrical method employs a capacitive coupling to a high frequency signal carried by the model wires. The results of the last two methods, together with signals from the trolley instrumentation, are simultaneously displayed on a multi-trace oscilloscope with recording camera, or on a multi-channel chart recorder.

Practical experiments have been in progress at Tolworth for only a few months but, already, considerable progress has been made. Results so far achieved show that the method of approach to the problem is the correct one and BICC scientists are hoping that their findings will soon be guiding the design of improved overhead equipment for all forms of electric traction.

The English Electric Co. in 1960

IN the field of meters and relays, a development that aroused interest was the welding meter for use in welding research and production. The meter comprises an ammeter, voltmeter and watthour meter and enables the electrical conditions of an a.c. welding arc to be observed.

A range of 240° instruments for traction purposes was also introduced. These instruments have black Perspex dials on which are engraved the numerals and divisions. Illumination from lights behind the mounting panel is refracted through the Perspex to spotlight the pointer and the engraved portions of the dial. The instruments are protected from the effects of vibration and shock and from damage by dust, oil and steam.

Industrial Control Equipment

During the year a wide range of static electronic control equipments has been developed, known as the "Unistat" range. It includes a variety of a.c. and d.c. variable-speed motor control schemes of the saturable reactor type and a full range of magnetic logic elements and contactless sensing devices. These equipments, together with the existing range of magnetic amplifiers, provide a comprehensive selection of static units for inclusion in the many industrial process control schemes with which the company is associated.

In the early part of the year the new sinter plant at the Workington Iron & Steel Co. Ltd. mills was equipped with variable-speed drives using the saturable reactor technique.

A production programme for a large number of multi-motor control centres to the most recent English Electric design was initiated to meet orders which have been received from many parts of the world. Some of the largest of these orders are for centres to be installed in Russia and the Argentine.

A number of the latest developments in the use of static techniques have been incorporated into many of the comprehensive control schemes built for the Metal Industries, Mining and Electrical Plant Sales applications divisions of the company.

Data Processing Equipment

Manufacture of the English Electric DEUCE computer has proceeded well and there are now over thirty operational installations of this machine. A new order was placed in October by the United States Advanced Research Projects Agency for a DEUCE Mk. 1, to be installed in the Applied Mathematics Department of Queen's University, Belfast.

The first production models of the KDP 10 commercial data processing system have been built; among them are those for the Commercial Union Assurance Company and the Yorkshire Electricity Board.

Pre-eminent among English Electric computer activities has been the design of a new and powerful high-speed computing system called KDF 9, which offers a completely new approach to the economics of data processing and is complementary to KDP 10.

The DATAPAC range of transistorised industrial data handling equipment is constructed as a multipoint scanner complete with analogue/digital converter and printer unit, suitable for industrial control systems applications, telemetry, and data logging. DATAPAC equipments delivered to customers during 1960 include multipoint temperature scanning and data logging systems for the nuclear power stations of the United Kingdom Atomic Energy Authority at Calder Hall and Windscale, and a data transmission system for the new semi-automatic plate mills of the South Durham Steel and Iron Co. Ltd.

The transfer of the English Electric Central Computing Bureau from Stafford to Kidsgrove was completed in the early part of last year without interruption to the comprehensive time-hire service this establishment provides to its many customers. This bureau and the London Computing Bureau have given uninterrupted facilities for the past five years.

Aircraft Equipment

Amongst new electrical equipment for aircraft introduced by English Electric during 1960 following an extensive development programme, were brushless generators, transistor voltage regulators and static sensing units.

Brushless rectifier type a.c. and d.c. generators made by English Electric have integral main and permanent magnet pilot exciters ensuring high fault clearing capacity, rapid voltage build-up and complete independence from other sources of power supply.

English Electric transistor voltage regulators are being manufactured for use with either a.c. or d.c. generators and have no moving parts. They give close voltage control with fast response, have no hysteresis effect, require no trimming and are unaffected by acceleration and vibration.

Static sensing units are made by English Electric for protection of three-phase a.c. systems in aircraft against over-voltage, under-voltage, reverse phase sequence and differential current conditions. They have no moving parts up to the final sealed relay and consist of a transformer feeding a Zener diode circuit operating a standard uncalibrated relay.

Ultrasonics in Industry

ULTRASONICS is dealt with in all its technical aspects in a new book published recently. "Ultrasonics and its Industrial Applications", by O. I. Babikov is translated from Russian and published by Consultants Bureau, New York. While the volume covers recent Soviet advances in this field, its scope is universal, and it will serve as an aid to all technicians and scientists interested in the industrial applications of ultrasound.

The author discusses fully ultrasonic control methods, the action of high-intensity ultrasonic oscillations on various technological processes, ultrasonic drilling techniques, and ultrasonic pulse methods of flaw detection and physico-chemical research. In addition, the fundamental physical principles are presented in concise form, making this volume a convenient reference for all technicians working in industrial research, metallurgy, acoustics, and the many related fields of physics and chemistry.

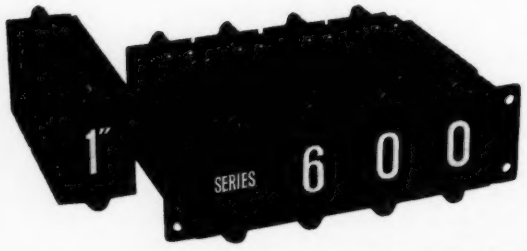
Circle 113 for further information

In-line Digital Display

Think of a number

—from 1 to 12, or any combination of letters, symbols or fractions, in white or colour, projected in clear, bold characters on to a screen for one plane presentation—and you will see the tremendous application of this C.I. Digital Display Unit. A system of 12 lamps which can be remotely controlled, projects through a system of lenses the figure, letter or symbol of your choice on to a viewing screen. Moreover, any number of these units may be grouped together or panel mounted with a common screen. Alignment is assured with perfect eye-appeal and a very wide angle of viewing.

Type numbers	*600 (for 6·3 volts).*
Operating Voltage	*6·3 volts, standard; also available 12 or 24 volts.*
Power Consumption	*2 watts.*
Figures	*Illuminated. 1" high by ⅛" wide.*
Case	*Matt black plastic with 2 fixing holes.*
Weight	*10 ounces.*



Single or grouped units

Counting Instruments Ltd · Elstree Way · Boreham Wood · Hertfordshire · England

Telephone: ELStree 1382

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SURVEY OF NEW INSTRUMENTS

ELECTRICAL · ELECTRONIC · MECHANICAL · NUCLEONIC · PNEUMATI

Microseal Switch

DOWTY ELECTRICS LTD. have recently introduced the microseal switch for aircraft and general industry. The switch meets an increasing demand for a waterproof unit capable of operating under the most severe conditions with complete reliability.

This "environment free" switch is designed to operate at altitudes up to 60,000 feet in ambient temperatures ranging from −75 to +70°C. The whole unit, which weighs 7 oz, has similar essential dimensions to other Dowty micro-switches and can replace them with little or no modification to existing structures.

Complete sealing is achieved by glass/metal seals interposed between the switch tray and terminal block, together with a silicone-rubber "O" ring and an associated nylon scraper ring in the plunger mechanism. The stainless steel plunger is given special treatment to ensure prolonged efficiency of the dynamic "O" ring seal.

The 6 BA terminals are arranged in a mica-filled, phenolic-resin terminal block and are protected by a synthetic rubber grommet. The switch action consists of a heavy-duty, double-pole, change-over contact arrangement which is shown in schematic form on the outer casing.

Internally, a rocker carries moving contact blades and a soft-iron armature which moves between two permanent magnets to provide a positive "snap action". A unique feature of this design is that contact pressure increases up to the moment of change-over, thus reducing the tendency to arcing normally associated with low contact pressures at this point.

To simplify the striker mechanism design, also to allow for flexing structures, the plunger has $\frac{3}{8}$ in. overtravel after the switch has operated. A load of $10\frac{1}{2}$ lb max. is necessary to operate the switch, while a load of 21 lb gives full plunger overtravel. At full overtravel, the top of the plunger is level with the top of the turret, thus preventing damage to the switch mechanism.

Circle **1** *for further details.*

Level Gauge Switch

PRIMARILY designed for use in cooling water header tanks on diesel locomotives, the R. & G. Type 1810 gauge switch, developed by Bayham Ltd., gives both a continuous pointer indication of water level, and an alarm contact at low level.

Both operations are magnetically controlled by the movement of the float arm: the pointer by magnetic attraction in order to give sensitive indication; and the switch by repulsion which in turn gives a snap over and positive locking action.

The switch itself, which has a standard rating of 6 amp at 110 volts d.c., is of mercury tube pattern with both electrodes in one end only. This tube snaps through 90° at the operating level, ensuring that the mercury is either in contact with the electrodes or, alternatively, up the other end of the tube. Thus it cannot splash over and give intermittent contact. In addition the differential between the trip and recovery levels is kept as large as possible so that water surge caused by pitching and rolling will not cause intermittent operation.

The front cover, which contains the dial chamber, is removable for wiring purposes. Since the pointer itself is a magnet, it automatically picks up the correct reading when this cover is replaced.

The R. & G. gauge switch can also be used in daily service fuel tanks and, in the case of electric locomotives, on transformer tanks to indicate the oil level.

Circle **2** *for further details.*

Ball Bearing Type Gearheads

VACTRIC (CONTROL EQUIPMENT) LTD. have brought out three new ball bearing type gearheads.

For light duty servo work, these gearheads employing exact ratios are invaluable where considerations of space and weight are important. They have been designed for use in control systems as a compact means of converting the motive power of servo motors into more manageable torques and speeds. Special care has been taken to ensure that the essential features of the servo motor are not impaired by the addition of the gear train. Miniature precision stainless steel ball bearings are used throughout.

The guiding specification in the design of these gearheads is E.L.1893, issued by R.A.E. Farnborough, and the units conform to the general life requirements for the environmental conditions in that specification. In fact, the design meets the more stringent requirements with respect to acceleration and vibration demanded by guided missile applications.

Where gear reductions are required other than directly after a motor drive, the speed reducer is particularly useful. It comprises a standard gearhead of any desired ratio, with an adaptor housing, carrying a shaft mounted in two precision ball bearings.

Gearheads may be mounted by the circular groove around the housing or by means of the four tapped holes in the front face of the housing.

The methods of mounting the gearhead to a motor is by means of a screwed adaptor.

	Size 10	*Size* 11	*Size* 18
Driving motor sizes	10, 08, 07	11, 10, 08, 07	18 and 15
Backlash at 4 oz in reversing torque on output shaft ...	1½° max.	1° max.	—
Backlash at 6 oz in reversing torque on output shaft ...	—	—	40′
Increase in lost motion per lb in. of additional reversing torque ...	50′	25′	5′
Inertia referred to input	0·01 g cm² (approx.)	0·01 g cm² (approx.)	0·1 g cm² (approx.)
Breakaway torque	¼ g cm max.	¼ g cm max.	¼ g cm max.
Running friction torque (on no-load)	¾ g cm. max.	½ g cm max.	—
Static torque ...	2½ lb in. max.	2 lb in. max. (ratio 10 : 1) 3½ lb in. max. (ratios 20 : 1 to 1,000 : 1)	30 lb in. max.
Momentary running torque (for 1 hour total during working life)	27 oz in. max.	1½ lb in. max. (ratio 10 : 1) 2½ lb in. max. (ratios 20 : 1 to 1,000 : 1)	20 lb in. max.
Safe side load on output shaft at ¼ in. from the normal mounting face	6 lb max.	8 lb max.	70 lb max.
Safe static axial load on output shaft	3 lb max.	15 lb max.	20 lb max.

Circle **3** *for further details.*

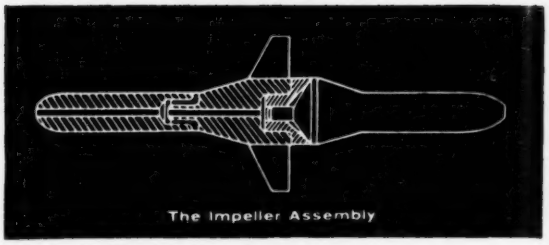
Electronic Flowmeter

METERFLOW LTD. have developed a new range of impeller-type flowmeters.

The sensing element of this free-impeller flowmeter consists of a dynamically balanced rotor, supported on two p.t.f.e. bearing brushes.

The rotor is machined entirely from austenitic stainless steel, and involves six blades spirally cut to ensure maximum efficiency and to reduce fluid slip, and, consequently, pressure drop, across the meter. The steel used also gives maximum corrosion resistance, making the flowmeters safe for use with highly corrosive fluids. The body of the flowmeter is machined from non-magnetic stainless steel which also gives maximum resistance to corrosion.

Owing to the inherent stability of the bearing materials used, the instruments are suitable for low-temperature applications including liquid oxygen.



Electronic flowmeter

The rotor element entirely eliminates bearing end thrust, enabling it to achieve extremely high degrees of accuracy. Normally, a pressure drop develops across the rotor blades which tends to force the rotor forward on to its outlet bearing, thus producing drag and reducing measuring accuracy. In the Meterflow element, however, this bearing consists of a conical seating which is in direct communication with the inlet to the flowmeter by means of a small drilling which passes through the entire length of the front bearing and the rotor assembly. Fluid at upstream pressure is communicated directly to the rotor bearing, producing a thrust which always compensates that developed across the blades. The system is self-balancing, since the fluid pressure developed on the outlet thrust bearing increases as the rotor moves forward. The value of the pressure developed on the outlet bearing is a function of the relative position of the rotors and the bearing housing, and this position always adjusts itself so that the pressure drop across the rotor equalises the thrust on the bearing. The rotor therefore always floats freely between the two bearings without making physical contact with them.

The calibration characteristics of the rotor in the Meterflow sensing elements are linear over a wide range of flows, but non-linearity will necessarily increase at low flow rates, since then the fluid pressure on the outlet bearing is insufficient to overcome the drag produced on the rotor. Nevertheless, the Meterflow instrument gives good accuracy and repeatability even at these low flows.

Screwed on to one face of the flowmeter is a pick-up which contains a magnet and a coil. The passage of the blades through the magnetic flux generates voltage pulses in the coil which can either be used to operate a Dekatron type of display unit or, alternatively, can be utilised to produce a d.c. voltage or current proportional to flow rate by means of frequency d.c. convertors.

Alternatively the signal may be used for totalising purposes. Sizes range from ⅛ in. diameter to 5 in. diameter, but larger diameters are in process of development.

The following is a brief specification:

(a) High order of accuracy. Repeatability is better than 0·1% with a linearity ±0·25% for a flow range of 8—1

(b) The self-generating electrical outputs enable meters to be used for remote indication, recording, totalising or control applications, employing either digital or analogue techniques

(c) There is only one moving part and no electrical contacts, and the normal wear problems

associated with positive displacement meters are, therefore, reduced to an absolute minimum

(d) It is easy to install. This type of meter only requires four diameters of straight pipe upstream of the flowmeter

(e) Low pressure drop. Less than 3 p.s.i. at maximum flow (for special application this can be reduced to 1 p.s.i.)

(f) High transient response

(g) Negligible effects from changes of viscosity

(h) High working pressure—3,000 p.s.i. maximum

(i) Suitable for use at temperatures ranging from −200°C to +200°C.

Circle **4** *for further details.*

Portable Double-beam Oscilloscope

SOLARTRON LABORATORY INSTRUMENTS LTD. announce their new portable double-beam oscilloscope, CD 1014.2, an improved version of the CD 1014 with additional trigger modes and provision for external brightness modulation.

Two identical wide-band Y amplifiers, numerous triggering time-base modes and built-in TV sync separators make the Solartron CD 1014.2 oscilloscope suitable for laboratory applications and for field servicing.

Both amplifiers are d.c.—5 Mc/s and have a sensitivity range of 100 mV/cm to 50 V/cm with ±5% measuring accuracy. Increased sensitivity of 1 mV/cm (at reduced bandwidth) is obtained from the built-in preamplifier preceding Y_2. The inputs may be "floated" with respect to chassis to display signals isolated from earth.

The basic time-base range 1 cm/μsec to 1 cm/sec (±5% measuring accuracy) may be extended to 5 cm/μsec with the X expansion. There is direct access to the d.c. coupled X amplifier of sensitivity 0·2 V/cm to 2 V/cm. The CD 1014.2 may be triggered internally or externally (positive or negative) on TV frame, TV line, Auto or Normal modes.

A "bootstrap" type circuit gives a linear time-base with less than 1% deviation. The 30 volt bright-up pulse, derived from a separate bi-stable circuit, gives bright displays at all sweep speeds. The time-base waveform is available at an output socket and provision is also made for external brightness modulation. A square wave of ½ V peak to peak ±1%, at mains frequency, is available for calibration of the time-base and Y sensitivity.

Stabilised e.h.t. ensures that calibration accuracy is independent of brightness levels on the 3½ in. diameter double gun c.r.t. 3AZP31. Mains input 90-130 V/200-240 V, 45-66 c/s.

Circle **5** *for further details.*

Portable double-beam oscilloscope

Precision Fine Wire

PRECISION fine wires from the American company Secon Metals Corp. are now available in this country from Leonard Wadsworth & Co. Ltd. Secon products include: 1,000°F insulated wire; resistance thermometer wire in pure nickel and in pure platinum; fine wire drawn to 0·0002 in. in diameter; ribbon rolled to 0·0001 in. thickness; a range of precision potentiometer wire, bare and insulated, from 37 to 600 ohms/circular mil foot; Woolaston wire; titanium wire from 0·02 to 0·001 in. diameter.

Titanium, strain gauge, semiconductor, filament, fuse, high tensile strength and enamelled wires are also available, together with pure gold galvanometer suspension strip and electroplated wire and ribbon.

A range of ceramic insulated wire for use in high temperature and nuclear environments is also available.

Circle **6** *for further details.*

High Voltage Silicon Rectifiers

1,500 p.i.v., 300 mA rated silicon rectifiers that exhibit stable characteristics at high temperatures are available from International Rectifier Co. (G.B.) Ltd. These units offer reverse leakages of 100 μA at 75°C (at rated p.i.v. of −1,500 volts d.c.). Maximum forward voltage drop at a test temperature of 25°C at 150 mA is 4·5 volts.

Designed primarily for high temperature operation, these units are stud mounted for optimum heat dissipation, and may be operated at temperatures up to 150°C. Their high inverse voltage (1,500 volt minimum) combined with the ability to withstand severe shock and vibration makes them especially suitable for missile and airborne equipment applications. Proper selection of polarity (either Type 1N1130 with cathode mounting, or Type 1N1131, anode mounting) eliminates the need for high voltage insulation between stud and chassis.

Circle **7** *for further details.*

High-precision Laboratory Furnaces

A RANGE of precision laboratory furnaces with exceptionally high stability of temperature (±0·25°C), an interchangeable drum control for thermal cycling, and facilities for heat loss compensation at the ends of the tube, have just been introduced by Shandon Scientific Co. Ltd.

In the standard range there are three models for maximum temperatures of 1,050°C with tube sizes respectively of 35 mm i.d. × 290 mm length (for operation on 115 V, a.c.), 60 mm × 450 mm (220 V, a.c.) and 75 mm × 700 mm (220 V, a.c.); and two models for maximum temperatures of 1,250°C, with tube sizes of 35 mm × 290 mm (115 V, a.c.) and 60 mm × 450 mm (220 V, a.c.). Two special models for maximum temperatures of 1,500°C are also available, with tube sizes of 16 mm × 250 mm (115 V, a.c.) and 35 mm × 400 mm (220 V, a.c.).

The standard models may be controlled either by a thermostatic regulator or a chronograph drum control for thermal cycling, these temperature-control arrangements being easily interchangeable by the user.

The thermostatic regulator enables the furnace temperature to be controlled within ±0·25°C at any desired level below the maximum. The device consists of a graduated scale and a pointer operated by a dilatable wire running through the furnace body. The scale is fitted with a stop which may be set to any desired temperature. When the pointer reaches the stop, the current is automatically cut off from the windings via the 8-volt relay. The temperature is set initially with the aid of a thermocouple.

The thermostatic regulator is interchangeable on the standard models with a chronograph drum control for thermal cycling. The drum is clockwork-operated as standard, but an electrically-driven version is available as an alternative. The drum carries a temperature chart on which the desired thermal cycling programme is marked out by a strip of thick cardboard. In operation, the drum revolves at a set speed (the gearing arrangements provide two speeds), and, as the furnace heats up, a specially-designed contact on an arm connected to the dilatable wire moves across the drum. When it meets the cardboard, the relay operates and the current is cut off. In this way the contact follows closely the edge of the cardboard strip, alternately making and breaking the circuit to the windings, and thus holding the temperature to the planned programme.

The three separate windings are mounted side by side along the tube and may be controlled individually by shunt rheostats, thus enabling the temperature to be varied along the tube for special work or to compensate for the extra heat loss at the tube ends inherent in this type of furnace.

All models may be mounted vertically or horizontally. For vertical mounting the furnace casings are fitted on each side with a drilled or tapped boss enabling them to be secured to a suitable support. For horizontal mounting three different bases are available—a metal tripod with screw adjustment on each foot; a box pedestal housing the relay and its associated transformer and incorporating a mains switch; or a potentiometric pedestal incorporating the relay and transformer, mains switch and three shunt rheostats for controlling the three individual windings.

All models may be fitted with a water jacket, e.g., for use in a glove box.

The two special 1,500°C models are developed from the standard types. They are available only with a chronograph drum control, which is not interchangeable with a thermostatic regulator, and incorporate special windings of platinum-rhodium wire. Like the standard models, they may be mounted either vertically, or horizontally on any of the three available bases.

Prices from £95, according to model. Delivery, six weeks.

Circle **8** *for further details.*

Test Socket

SEALECTRO CORPORATION announces the availability of a new Teflon-insulated test socket designed for assemblies where space is at a premium. The new unit is designated as Type SKT-37.

The Sealectro "Press-Fit" SKT-37 receives a 0·090 in. diameter probe, 0·140 in. long. Overall diameter, above the chassis, is only 0·218 in. while overall height, including mounting shoulder and soldering stud, is only 0·340 in. The new test socket has a 0·170 in. diameter body for the through-chassis mounting.

The electrical contact for the test probe is of beryllium copper, providing positive, low-resistance conductivity for accurate take-off measurements. The body is made of a solid piece of machined, virgin Teflon permitting the usual Sealectro "Press-Fit" installation, thereby saving time and costs on the assembly line, and simultaneously providing a termination that will withstand a wide range of ambient and operating temperatures without loosening, cracking or charring.

Circle **9** *for further details.*

Electromagnetic Shaft Speed Transducer

IT is sometimes desirable to measure the speed of a rotating member without actually applying a load which might alter the speed of rotation (e.g., mechanical tachometer) or where no physical connection is possible.

The Ericsson electromagnetic transducer has been designed for use under such circumstances. It has no moving parts to wear out, and the whole of the unit is encapsulated in epoxy resin.

The transducer consists of a polarised electromagnet assembly with a large air gap. The poles of the electromagnet are mounted close to the rotating shaft so that any irregularity of ferrous material (i.e., bolt head, keyway, etc.) changes the reluctance of the air gap. This change causes a pulse in the output circuit. The output pulses can be fed into any suitable electronic counter with or without amplification as necessary. By the choice of the correct number of gear teeth and using a time gated counter the transducer can be used as a direct reading tachometer.

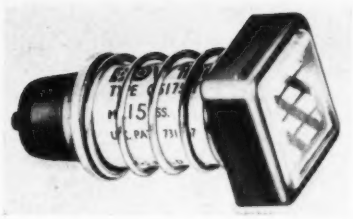
The output pulse amplitude will vary depending upon the frequency of the pulses and the gap between the polepieces and the operating shaft irregularity.

Circle **10** *for further details.*

Automatic Filling Machine

SHANDON SCIENTIFIC CO. LTD. have recently introduced to this country a fully-automatic filling machine, known as the "Filamatic", designed to dispense pre-measured quantities of liquid, automatically and continuously, at a uniform selected speed.

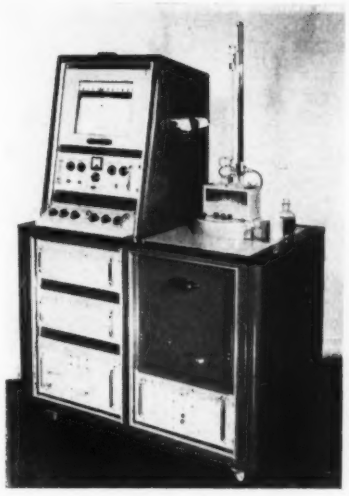
The "Filamatic" may be fitted with interchangeable glass or stainless steel syringes of 1, 3, 5, 10, 20, 30 or 50 ml capacity, and special large models are available up to 1040 ml capacity. It will handle any free-flowing



Dowty 3-position magnetic indicator

◀ *"Filamatic" automatic filling machine*

Pulse polarograph A1655 ▶



liquid from water-thin solutions to light oils, polyester and epoxy resins, agar gel, etc.

The machine provides an accuracy of better than 1%, and has applications in industry for filling vials, ampoules, bottles, tubes, etc., and for metering small quantities of liquids in production processes. It may also be used for laboratory work—e.g., for dispensing reagents in series tests or, with a "single-shot" attachment, for such operations as the rapid inoculation of large numbers of laboratory animals.

The "Filamatic" incorporates an electronically-controlled, variable-speed drive, providing stepless speed-control at constant torque, regardless of load variations. The volume of liquid discharged at each stroke is regulated by an eccentric on the crankshaft and is adjustable by a micrometer control.

The machine is extremely robust, requiring no maintenance beyond the replacement of two inexpensive thyratron valves after 2,500 hours' operation, and the whole pumping mechanism is rapidly removable for cleaning or sterilising.

Among the factory-fitted optional extras available are a synchronising attachment permitting several machines to be "ganged"; an automatic timer for re-cycling machines operating together with the synchronising attachment; an electric counter; and a single-shot attachment for use with a foot switch.

Accessories which may be fitted after production include a dual-valve attachment, for increased accuracy where this is desirable; a non-drop delivery nozzle; an adaptor enabling Luer-Lok syringes (up to 10 ml) to be used; an all-glass filter attachment; a foot switch; and a fixed filling-head for attachment to the machine housing.

Prices of the "Filamatic" range from £125 10s. 0d., according to model, and delivery is approximately eight weeks.

Circle **11** *for further details.*

3-position Magnetic Indicator

IMPROVED systems of control emphasise the need for rapid visual indication and warning equipment. Modern remote-control panels must show, both positively and with complete reliability, that the system concerned is functioning correctly—or, more important still—if a failure has occurred. These stringent requirements are met by the 3-position magnetic indicator, a product of Dowty Electrics Ltd.

The three display patterns are formed on prisms actuated by twin solenoids. The first pattern is shown when one coil is energised, the second when the other coil is energised and the third pattern when the unit is de-energised. Twin-solenoid actuation gives immunity from filament failure. The display surface is $\frac{3}{4}$ in. square and a wide range of patterns is available. When used with systems incorporating "Plasteck" transpanel lighting, an alternative window is supplied.

Supply requirements for the Dowty indicator are 0·067 amp nominal at 28-30 volts d.c. The weight of the unit is 2·2 oz. These units have a life expectancy of over 1,000,000 operations and have passed the most exhaustive vibration tests. The indicators are approved for use by the Admiralty, the Ministry of Supply and the Air Registration Board.

Circle **12** *for further details.*

Pulse Polarograph

THE pulse polarograph has been developed at Harwell to overcome the limitations of square wave polarography when applied to irreversible reductions, and is capable of operation with base electrolytes 100 times more dilute. It is being manufactured by Southern Instruments.

The instrument is capable of producing both normal and derivative polarograms, it being possible to detect reversibly and irreversibly reduced ions at concentrations of 10^{-8}M and 10^{-7}M respectively. Effects due to residual current, and to high concentrations of ions reducing at a lower potential, have been largely eliminated.

The pulse polarograph is in console form with 12-inch eye-level chart recorder, thermostatically controlled electrode system and self-contained hydrogen generator for deoxygenation.

Circle **13** *for further details.*

Wet Collector

THE Airmix wet collector, which has just been developed, has a variety of uses in applications involving industrial dust collection. Apart from its use on new systems, it is easily adapted for installation as a secondary collector on existing plants where increased efficiency is desired.

This device is a self-induced spray type vertical Venturi wet washer which separates the dirty water from the cleaned gases by means of centrifugal action. The washing water is fed tangentially to the Venturi throat by two, three or four pipes depending on the size of the collector. The gases flowing through the throat at high speed spread the water on to the cylindrical surface in a continuous film and at the same time carry it vertically. The difference in the velocity of the two fluids causes the gas to break up the waves which form on the surface of the water film, thus intimately mixing the dust-laden gas and the water droplets in the fine spray produced.

The mixture then enters a tapered diffuser section where its speed is slowed down and the dust particles which have so far escaped are wetted as the dust-laden gas again passes through a cloud of water droplets which, owing to their tendency to agglomerate, have a slower upward movement.

Upon reaching the top section of the Airmix the mixture is diverted into a ring of curved vanes which impart a strong rotational motion which separates the gases and water by centrifugal action. Any particles still in a dry state are wetted by impingement with the vanes. The dirty water is evacuated by a discharge pipe and the cleaned gases pass out through a chimney.

There are two types of sludge disposal system available, one consisting of a small three-compartment tank which separates the slurry through a discharge valve and another consisting of a large two-compartment sludge settling and dewatering tank in which the sludge is allowed to settle for eventual discharge down a chute into lorries for disposal, the clean water being fed in both cases back to the Venturi throat.

The Airmix has been successfully used on coal, coke, sugar, in the foundry and quarrying industries, and in many other fields. It has been used in the chemical industry for the drying of chlorine, for the washing of nitrous, sulphurous and ammoniac vapours and as a pre-filter before a wet electrostatic filter.

The unit is constructed of mild steel and is available in a range of standard sizes with capacities from 1,300 c.f.m. to 30,000 c.f.m. For handling larger volumes a number of smaller units can be operated in parallel. A galvanised finish or, for certain applications, corrosion resistant linings or special materials such as stainless steel can be supplied.

Full details are available from Thermix Industries Ltd., a member of the Dunford & Elliott Engineering Group.

Circle **14** *for further details.*

Automatic Weighing and Pre-packing Machine

W. S. BARRETT & SONS, of Boston, Lincs., are now selling a potato weighing and pre-packing machine as will be seen in the illustration. It is a compact unit consisting of two belt elevators on which are slats. The potatoes are fed from the "brusher" to the hopper through which the elevators pass. The potatoes are then elevated and, at the top, drop into the "scale" hoppers. The required weight being achieved, the "scale" will have dropped to its lower limit and the elevator will come to a stop whilst the operator tips the hopper so that the potatoes drop into a polythene bag she holds, ready for sealing and despatch.

On the scale recovering its zero level the elevator commences working again.

Incorporated in the Barrett weighing unit is a photocell and light head together with a simple mechanism which stops and starts the elevator.

This electronic device is made by Electronic Machine Co. Ltd. and consists of a photo-electric cell and light head with a special lens attachment which reduces the light beam to a pin point.

A finely balanced arm, which is in no way mechanically attached to the scale or its mechanism, is made to move as the scale pan descends and this movement allows a piece of metal or "flag" to gradually rise and it is when the scale has come to rest according to the pre-determined weight that this "flag" interrupts the light beam and thus actuates the mechanism to stop the conveyor.

Recovery of the scale pan ready for the next "weigh" automatically allows the "flag" to drop and the "light beam", thus becoming uninterrupted, sets the conveyor in motion again.

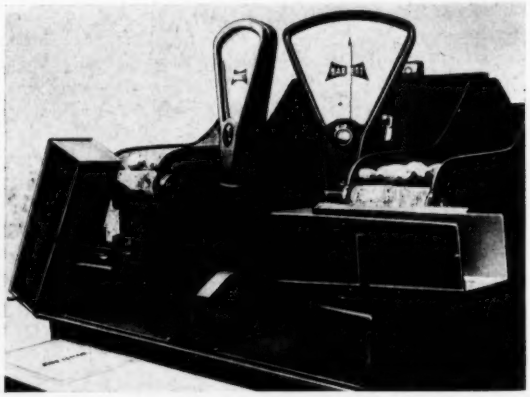
Although designed in the first place for potatoes, the whole unit can of course be used for fruit and other types of product. Particulars of the electronic control device may be obtained from the Electronic Machine Co. Ltd.

Circle **15** *for further details.*

Texlite Pack-cushioning Material

TEXLITE is a new pack-cushioning material of crimped rubberised hair just developed by the Hairlok Co. Ltd.

Although the same basic materials—curled hair bonded with a carefully compounded latex rubber—are used to make Texlite as for the company's other rubberised hair sheet, moulded and modular units, the new production technique is a major break-through.



Barrett potato weigher and packer with Electronic Machine Co. Ltd.'s photocell control

Curled hair is carded into a delicate uniform layer of light density, gently gathered by a system of needles and condensed. Not only is the original curl of the hair preserved, but a crimped structure is developed through the needling action. This gives Texlite exceptional resistance to stratification and a resilience never before achieved in high-density rubberised hair.

Better protection is afforded by 1 lb of Texlite than by 2 lb of ordinary rubberised hair.

After 30 consecutive drops from a height of 4 ft 6 in., the shock transmitted to the Texlite-protected pack increases only by approximately 10%. Saturation of the material with water even improves shock attenuation slightly.

The low weight of Texlite per unit of shock absorption, with consequent substantial weight and space reductions in transit, makes it the ideal cushioning material for the packaging and transportation of electronic and other delicate instruments, control equipment, fragile electrical apparatus and machine parts, etc.

The standard densities are 4 lb and 6 lb per cu ft, in thicknesses of 1 in., 1½ in. and 2 in., but other densities can also be obtained. Texlite is manufactured in sheet form, but the Hairlok Company undertakes to cut and fabricate to individual requirements. The new product conforms in every way to the various Government and Armed Services specifications which are applicable to cushioning materials.

Circle **16** *for further details.*

Strobotac

THE GENERAL RADIO Type 1531-A Strobotac is a stroboscopic tachometer newly developed by the company.

A Strobotron lamp produces white flashes of high intensity and short duration, enabling machines and processes to be observed in fine detail and natural colour under normal room and industrial lighting conditions.

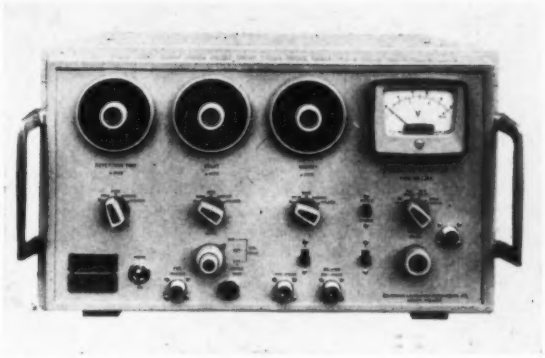
The flashing rate is adjustable from 110 to 25,000 flashes per minute, in three overlapping ranges, and accuracy is ±1% of dial setting. The range selection switch and control dial are concentric for ease of operation, the range in use being clearly illuminated. Speeds of up to 250,000 r.p.m. can be measured using flashing rates that are submultiples of the speed to be measured.

The lamp is housed in a parabolic reflector which can be rotated through 360 degrees horizontally and 180 degrees vertically, enabling the light to be directed exactly as required.

The instrument is light and compact, and is truly portable. It is contained in a flip-tilt case which provides complete protection when closed, and adjustable positioning of the control panel when open. It can be placed on a bench or table, held in the hand, or carried round the neck using the neck strap provided.

The net delivered sterling price of the Type 1531-A is £156, inclusive of import duty, and delivery time at present is 6-8 weeks from receipt of order from Claude Lyons Ltd.

Circle **17** *for further details.*



Single and double pulse generator

Single and Double Pulse Generator

THE new Solartron decade pulse generator, GO 1005, is suitable for accurate determination of transmission characteristics and transient response of amplifiers and networks, or testing the frequency and amplitude limits of electronic counters. This instrument provides positive or negative going, single or double rectangular pulses of up to 100 volts amplitude at repetition rates from 10 c/s to 1 Mc/s.

Three sets of concentric decade controls, with illuminated dials, permit coarse and fine adjustments of pulse duration, repetition rates and signal delay; with the aid of the built-in amplitude monitoring meter, output requirements may be set up with ease and accuracy.

Signal delay time, relative to a 10 V pre-pulse output, is variable over the same range as the rectangular pulse duration, viz., 250 mμ sec to 100 msec.

In the double-pulse mode of operation the leading edge of the first rectangular pulse coincides with the pre-pulse and the leading edge of the second identical rectangular pulse occurs after the set signal delay.

A delayed pre-pulse is also made available approximately 250 mμ sec after the pre-pulse, thus providing a trigger output which may be made to coincide exactly with the leading edge of the main rectangular pulse.

The extensive delay facilities incorporated and its internal or external (up to 2 Mc/s) triggering modes make the GO 1005 a versatile and accurate pulse generator suitable for almost any application.

Circle **18** *for further details.*

Direct Reading Inductance and Capacitance Meter

THE Solartron L-C meter, MM 906, is ideal for quick, accurate component checks and *in situ* measurements of inductance and capacitance, including "strays". With minimum f.s.d. ranges of 0 to 3 μH and 0 to 3 pF, this instrument is applicable for optimising component and wiring layouts in circuit development. It provides a continuous monitor of L and C from 0 to 300 μH and 0 to 300 pF respectively, in five ranges with ±3% accuracy. This accuracy is maintained with resistance loads of 20 kΩ shunt, 10 Ω series on "Inductance" setting and 0·1 MΩ shunt on "Capacitance" setting. A "guard voltage", sufficient to drive to 200 pF, enables the elimination of effects due to unwanted capacitances.

Valve interelectrode capacitances may be measured with ease, giving clear, accurate readings on the 4 in. scale of the Solartron direct reading L-C meter, MM 906, which weighs only 10 lb.

Circle **19** *for further details.*

Dumont Dual-beam Oscilloscope

AVELEY ELECTRIC have introduced into the United Kingdom the Dumont oscilloscope, Type 411.

This oscilloscope is an ultra-high sensitive instrument which combines the display capabilities of two ultra-high sensitivity oscilloscopes, each displaying on an independent beam of a dual gun c.r.t., and on a common time base, the conventional dual-beam presentation invaluable for comparison studies such as input *vs.* output. Each vertical channel may be operated independently of the other with complete amplitude calibration facilities on both. The common time base can be a precisely calibrated sweep to complete the quantitative analysis or, if desired, an uncalibrated expandable sweep.

The ultra-high sensitivity X-Y plotting is controlled from the front panel. Th esignal applied to the vertical axis of one channel may be fed to the horizontal axis of the other, thereby providing a complete, extremely sensitive scope with identical X and Y amplifiers. In this condition, there is still an unused beam and the sweep generator available to the operator. This can be used, for example, to display either of the above signals against time, or for timing, angle or other markers.

The calibrated sweep range of the 411 extends from 1 sec/cm to 1 μsec/cm in 19 convenient steps. Slower sweep speeds are available by connection of external capacitance at a rear terminal board. Uncalibrated sweeps are continuously variable from 1 sec/cm to 2 μsec/cm.

Either driven or recurrent sweep modes may be selected at the front panel.

The Dumont 411 will synchronise on positive or negative signals picked off from the Y-amplifier of either channel, external signal, or the power line—depending only on the setting of a front panel control.

Calibrated sweep linearity is such that any 10% increment is within 3% of any other 10% increment of the sweep.

Sweep can be expanded without distortion up to 5 times full-scale (50 centimetres) and any 10 cm portion of the sweep can be positioned on screen. Linearity of these on-screen displays is such that any 10% increment shall be written 15% of any other 10% increment within the full-scale limit.

The 411 is designed for convenience in operation, interpretation and servicing; and all controls have been visually and physically separated according to their function.

Circle **20** *for further details.*

Precision Potentiometers

ANCILLARY DEVELOPMENTS of Camberley announce two additional new types of precision potentiometers. These are synchro size low torque toroidal potentiometers and the size 15 slide wire resistor.

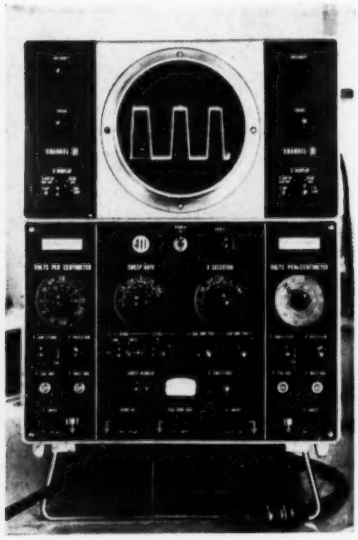
The basic features of the former is a precision wound toroid, precious metal wiper, with graded ball races mounted in an aluminium case. Linearity of 0·1% with a starting torque of 2 g/cm is claimed for all ranges from 100 Ω to 100 kΩ.

The slide wire resistor, available up to 1,000 Ω, is virtually unaffected by end play or vibration.

Circle **21** *for further details.*

Ultrasonic Thickness Measuring Equipment

AVELEY ELECTRIC LTD. have introduced into the U.K. the Kretz ultrasonic thickness testing instrument, Type Series 6000. The equipment, which incorporates a high stability wide band amplifier having a frequency range of 3 Mc/s - 20 Mc/s, has been specially designed to include facilities for the accurate measurement of dilation or contraction, and a special triggering circuit to give warning when a pre-determined limit of measurement has been reached.



◀ *Dumont ultra-high sensitivity dual beam oscilloscope*

Ultrasonic instrument for thickness gauging ▶

Precision potentiometer

Thickness measurements are accurately obtained by spanning several pulses with a movable pedestal whose leading edge can be moved to divide the first cycle of each ringing pulse. The higher the number of echo-pulses used for measurement, the greater the discrimination obtained. The vertical deflection response of the trace is better than 0·05 microseconds so that an echo-time discrimination of 0·0125 microseconds is obtained.

The unit has an effective depth range from 1 cm to 70 cm for flaw detection, and for thickness gauging a maximum range of 20 mm dependent on frequency and attenuation of the material under test. The power consumption is 180 VA. A low voltage socket is provided for certain types of work where stringent electricity safety precautions are essential. The use of this socket automatically makes the high voltage connection inoperative.

Circle **22** *for further details.*

Digital Clock

THE Microcell digital clock, Type 354, has been developed as a module for the Microcell Type 300 data logger/alarm scanning system, and fits standard 19 in. racking.

It is also available as a self-contained instrument.

Basic drive frequency at 50 cycles is derived from the mains, and this is divided down in transistor stages to 1 cycle per second. Subsequent frequency division is carried out on miniature plug in uniselectors to give hours, minutes and seconds.

A 6-decade digital display shows the time as hours, minutes and seconds and output is available on 6 of 45 lines to operate a printing device.

Programmed time intervals giving a contact closure or voltage pulse can be called up at 1, 2, 5, 10, 20, 30, or 60 minute intervals by selection of appropriate switch positions. In addition, the same contact closure or voltage pulse can be given at precise hourly times by merely putting a pin in a 24-position miniature pin board, e.g., typical programmed times such as 0000, 0600, 0800, 1100, 1500, 1800 can be called up.

Specification

Display	6 digital indicators giving hours, minutes and seconds
Output for Printer	45 lines, 6 of which are energised at any one time
Output Level for Printer ...	+12 V, −12V, −24 V, contact closure or external supply (selected by plug board)
Programmed Time Intervals	1, 2, 5, 10, 20, 30 or 60 minutes
Programmed Precise Times	24-hole pin board, selecting any precise hourly time. Total number of selections—24
Programmed Output Level	−24 V make or break −12 V make or break +12 V make or break Contact, make or break All contacts make or break for 500 ms
Repetitive Pulse Output ...	500 ms contact make or break at 1 second intervals
Accuracy	Synchronised to mains. Provision is made for feeding in external crystal drive
Supply	110, 200 to 250 V, 50 cycles
Unit Dimensions	19 in. × 7 in. panel × 12 in. deep

Circle **23** *for further details.*

Battery-driven Speech Recorder

ARROW LTD., a subsidiary of W. H. Sanders (Electronics) Ltd., are now marketing a small portable dictating machine measuring $8\frac{3}{4} \times 6 \times 3\frac{1}{2}$ in. and weighing $4\frac{3}{4}$ lb., complete with four standard U2 leak-proof torch batteries. It is designed to meet the demand for a reasonably priced portable speech recorder, which can be used in the office, at home, in the car, or while carried over the shoulder, as, for example, at exhibitions, or when stock-taking. It is provided with the usual accessories to enable it to be used as a transcription machine in the office.

The recording medium is standard $\frac{1}{4}$ in. magnetic tape on standard $3\frac{1}{4}$ in. spools, which may be fitted in transparent plastic cassettes for easy handling and changing.

Dictation time on one track of the tape is 22 minutes, affording 44 minutes for both tracks. A set of new batteries provide an intermittent running time in excess of 50 hours. Control is provided by one small lever having four positions—off, record, fast rewind and play-back.

The microphone, which is also used as audio reproducer, is fitted with a switch to start and stop the recorder. Instantaneous braking avoids loss or partial loss of words on play-back for typing. The circuits are entirely transistorised and the recording intensity is automatically kept at the correct level. A volume control is provided for play-back. The recorder can be used in any position. The case is of shock-resistant plastic material, the top cover being transparent to enable the position of the tape supply to be seen at a glance.

As a separate unit, a foot-operated switch is provided for transcription purposes, together with stethoscopic earpieces for the typist. Additional items are a small loudspeaker and a telephone pick-up device to enable telephone conversations to be recorded.

Price, including microphone, batteries, cassette with spools and tape, will be in the region of £25.

Circle **24** *for further details.*

50 c/s Harmonic Analyser

A PORTABLE battery-operated harmonic analyser has been built for the British Transport Commission by the Transmission Division, Telephone Manufacturing Co. Ltd., to British Post Office electrical design.

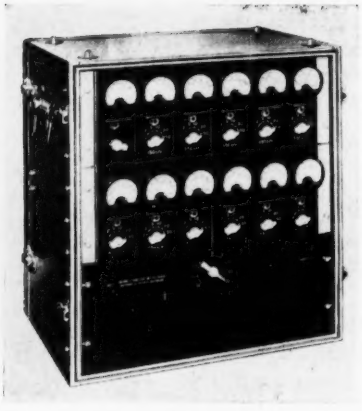
The analyser is used to measure the magnitude and frequency of harmonic interference from electrified traction and power distribution cables into adjacent telecommunication systems.

The instrument is fitted with indicating meters, but output terminals are provided to enable the outputs to be fed through a translator for permanent record by an electronic digital recorder.

The analyser comprises an input attenuator panel for controlling the input voltage, an oscillator and calibrate panel for setting up and checking the analyser units, and twelve plug-in selective measuring units each accepting one of the following frequencies:—

50, 150, 250, 350, 450, 550, 650, 750, 950, 1,150, 1,350 and 1,550 c/s.

Direct filtering is used to remove all but the particular harmonic of interest. Attenuators are included in



50 *c/s harmonic analyser*

Control relay

Wide range R-C oscillator

each unit to enable voltage range switching to be used.

The output from each of the twelve measuring units terminates in a 0-100 mV meter. The meters, arranged on the front of the analyser provide a simultaneous display of the fundamental and each of the eleven harmonic voltages. By photographing all the meters together a permanent record of the harmonic relationship at any particular instant can be made.

The analyser is contained in a transportable wooden case, 1 ft 11 in. × 1 ft 9 in. × 1 ft 4 in. A metal framework suitable for mounting 19 in. panels is fitted inside the case. The input attenuator panel and the oscillator and calibrate panel are 19 × 3½ in. panels mounted directly on to the metal framework. The twelve harmonic analyser units are mounted on the framework as a separate sub-assembly with each analyser as an individual plug-in unit.

Performance

Fundamental frequency range ...	49·5—50·5 c/s
Input impedance	10,000 Ω
Input voltage for full-scale deflection at maximum sensitivity:	
(a) fundamental	100 mV
(b) harmonics	10 mV
Range multipliers:	
(a) for all components ...	0·1, 0·2, 0·5, 1, 2, 5, 10, 20 and 50
in addition for	
(b) fundamental	10 and 50
and	
(c) for each individual harmonic	1, 2, 5, 10, 20, 50
Accuracy of indication	Approximately 1%
Power supply	15 V, 100 mA, d.c.
Ambient temperature range:	
(operating)	+10 to +30°C
(storage)	−10 to +50°C

Circle **25** *for further details.*

Control Relay

A NEW industrial control relay is announced by Square D Ltd.

This addition, designated Class 7001 Type D, is a compact, 10 ampere maximum, 250 V, d.c. operated relay, the contacts of which can be used to switch a.c. or d.c. supplies. With the exception of the magnet system, this relay is an exact replica of the a.c. operated relay already produced by this company.

The relay is manufactured in three basic types. The first provides up to four contacts, the second up to six contacts and the third up to ten contacts. All relays have identical mounting dimensions. This facilitates substitution of one relay for another. The relay can be disassembled, whilst in situation, from the front.

Although small in physical size, overall construction is robust for long, trouble-free mechanical and electrical life. Operating coils are available for voltages up to 250 V d.c. and are encapsulated in an epoxy resin moulding which gives protection against mechanical damage and moisture absorption.

All contacts are double break, silver to silver. Terminals are provided with pressure wire connectors and tilted for ease of installation.

Also newly available for use with these relays is a mechanical latching attachment, designated Class 7008, Type M1, to convert relays from electrically held to mechanically held. This attachment has identical mounting holes to the relay, thus permitting easy conversion from one type to another after installation, without increase in mounting area.

Circle **26** *for further details.*

Wide Range R-C Oscillator

THE new portable Solartron R-C oscillator, CO 1004, is ideal as a wide range general purpose laboratory instrument. This instrument provides symmetrical low distortion sinewave outputs, of 0 and 180° phase relationship, over the wide frequency range of 10 c/s to 1 Mc/s. A "balance" control is incorporated to obtain perfect symmetry about earth, at low frequencies.

A five position range switch and the fine control of the clearly scaled dial gives a continuous and accurate coverage of the entire frequency range.

CO 1004 utilises advanced circuitry in a balanced Wien network with variable capacity tuning giving a frequency accuracy within ±2·5%. The frequency stability is such that, over an eight hour period, the set frequency is held to within ±0·2%.

Total harmonic distortion is less than 1% between 20 c/s-200 kc/s and less than 2% outside these limits.

The output level per phase is continuously variable up to 20 V r.m.s. into loads greater than 20 kΩ, 10 V r.m.s. into 600 Ω. Amplitude stability over the entire frequency range is better than ±5%.

Circle **27** *for further details.*

"Dot" Diode

To meet the requirements of modern microminiature circuit techniques, Hughes Semiconductor Division in the U.S. has developed a microminiature diode called a "dot" diode.

The laboratories of Hughes International (U.K.) Limited at Glenrothes, Fife, Scotland, have been equipped to produce this type of diode.

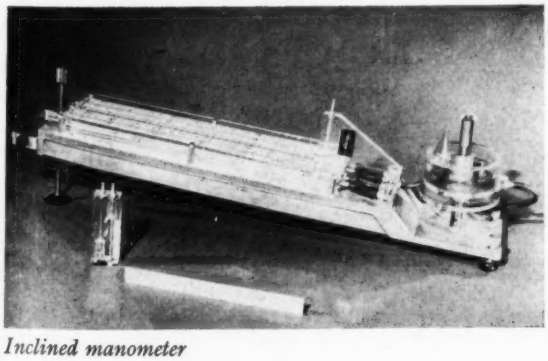
This diode is a silicon unit with a very low leakage high temperature operation and high forward current. Specification limits are:

100 mA forward at 1 volt
0·1 μA reverse at 50 volt d.c.
100 volt breakdown at 10 μA
Operating temperature range −55 to +100°C.

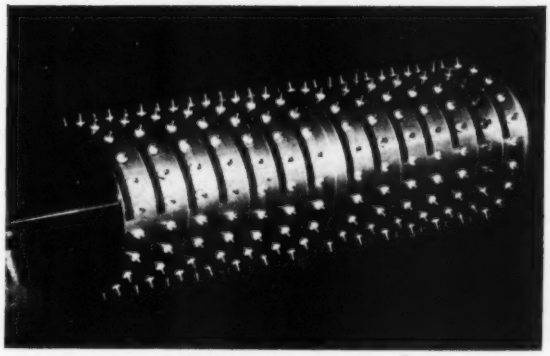
Circle **28** *for further details.*

Inclined Manometer

COMBUSTION INSTRUMENTS have recently constructed a special inclined-tube manometer for the Aerodynamics Division of the National Physical Laboratory, which may be of interest to other bodies doing similar work. Four tubes with a working length of 20 in. are mounted on a cast aluminium bed-plate which can be moved from 2-10° to the horizontal. The requirement that at both extremes of angle all tubes should read the same made great demands on the accuracy of construction. Formerly, glass tubes have been used, but it is very difficult to get straight lengths, and in practice it has been necessary to strain them into the correct degree of rectilinearity. The new Combustion Instruments manometer uses holes drilled in blocks of Perspex approximately 1 in. square in section. In order to give accurate readings at all angles, it is still necessary to make some adjustments but this can obviously be done with far less risk than if glass were to be used. The reservoir is cylindrical in shape and is carried on an accurately-cut threaded pillar mounted at 85° to the bed-plate (so that it is never more than 5° out of the vertical). Levelling screws are provided, and a sighting tube above the zero mark enables one to determine the angle at which the table is set.



Inclined manometer



Potentiometer with 294 *tapping points*

In use, one of the four tubes is usually left open to give a zero reading, since even with so large a reservoir the movement of level is appreciable, especially with the instrument in its most sensitive position.

The photograph also shows one of the smallest of the Combustion Instruments manometers for comparison; a little upright mercury gauge reading 0-35 in. w.g. or 0-2½ in. mercury. This is very accurate but unspillable and almost unbreakable.

Circle **29** *for further details.*

Potentiometer

GENERAL CONTROLS LTD. have just completed a servo gang wirewound potentiometer with 294 tapping points. The unit has been made for a special computing application, and consists of 14 gangs of their PR.35 Series, each gang having 20 segments, i.e., 21 tapping points per gang. Each tap has been individually welded on to a selected turn of the winding, thus ensuring the best accuracy on electrical positioning of the taps, within the limits of the resolution of the winding. This potentiometer has an extension spindle and a low operating torque for a 14 ganged unit of 2 oz/in.

Circle **30** *for further details.*

Flame Failure Unit for Oil Burners

THE FSP3 control unit is intended for use with many types of domestic and industrial oil burners, both manually ignited and push-button spark-ignited. It is used in conjunction with a photoelectric viewing head, Type VH83.

It gives normal flame relay operation—i.e., the fuel valve is maintained open while flame is present, and is immediately shut down on flame failure. For starting up, however, an over-riding timing device is incorporated in the unit, operated by a push-button on the lid. On pressing and releasing this start button, an electronic timing circuit comes into operation which energises a separate timing relay so that the fuel valve is held open.

The timing relay de-energises again at the end of the pre-set interval (adjustable between the approximate limits of 1 and 100 seconds by means of a control within the unit) and if the burner has not lit up successfully and been detected, the fuel valve closes. However, if the burner has lit successfully within the allotted time and the flame relay has energised, the fuel valve remains open when the timing relay drops out.

Terminals are provided for connection to an ignition transformer which will be similarly maintained on until the end of the time interval.

The unit is provided with a "flame-on" indicator lamp, and also with contacts for operating an external flame failure alarm. When the start button is depressed, the alarm is muted until the end of the start-time.

It will be seen that the FSP3 provides a very neat and complete self-contained start-up and flame failure control unit for oil burners, and does away with the expense and wiring involved in using a separate over-riding timing switch.

The price is £28 for the unit and viewing head complete. It is available from Elcontrol Ltd.

Circle **31** *for further details.*

Miniature Silicon Diode

A NEW miniature silicon diode is now in production at the Lincoln factory of the AEI Electronic Apparatus Division. This diode is of double-ended construction and is enclosed in a hermetically sealed glass envelope $\frac{1}{16}$ in. diameter and $\frac{1}{4}$ in. long. It is capable of rectifying currents up to 0·25 amp.

AEI offer a series of these diodes (known as Types MS1H to MS5H) divided into p.i.v. ratings from 60 V to 300 V. All types are rated 250 mA maximum mean forward current, and at a forward current of 200 mA the maximum volt drop is 1 V at 25°C. At the diode's maximum permissible junction temperature of 150°C and p.i.v. the maximum reverse leakage current is 50 μA for the 60 V and 100 V diodes or 100 μA for the 150 V, 200 V and 300 V diodes; at 25°C the maximum leakage is 1·0 μA for all types. The maximum junction capacitance is 5 pF and stored charge during inverse recovery 20 mμC.

These devices can be used as general purpose diodes or low power rectifiers. Their small size and light weight will appeal to computer, radar, and aircraft equipment manufacturers.

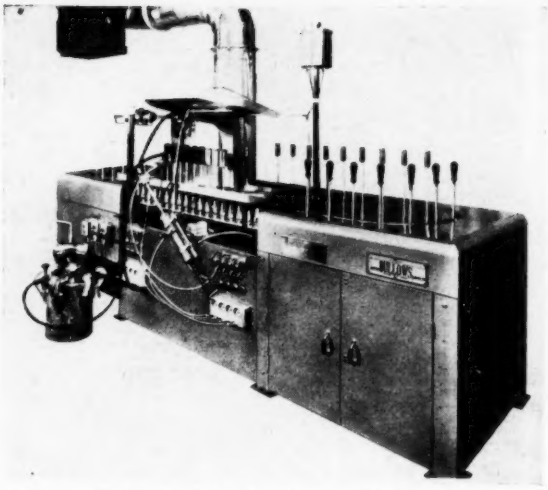
Circle **32** *for further details.*

Conveyorised Automatic Spraying Machine

THIS spraying machine has been developed by Alfred Bullows & Son Ltd. Each basic unit consists of a conveyor track; a spraying station comprising one spray gun, a gun traverse motion and brackets and a down draught exhaust system.

Apart from the air required for spraying purposes, power is provided by two electric motors. One drives a gearbox via a 5-speed step cone pulley, which in turn, through a series of shafts and cams, drives the conveyor chain, operates the gun motions and also the automatic spray gun operating valve. The extent of the gun motion is determined by the profile of the appropriate cam, of which a standard range is available. The length of spraying time is infinitely variable by means of adjustable cams. Compressed air at 60 p.s.i. is required to operate spray guns and valves.

Dependent upon the rate of production required and the type of article to be sprayed, the unit can be fitted with a 2 in., 3 in., 4 in. or 6 in. pitch chain into which workholders fit, and as standard has approximately 25 ft of chain. This can be extended either when



Conveyorised automatic spraying machine

supplied or at a later date if required. Since of necessity workholders will vary in size and shape, they are not included in the basic price of the unit and are available as extras. On this new machine, the conveyor is in constant motion and guns, when spraying, follow the work targets. This reduces inertia problems and greatly simplifies the mechanism, entirely eliminating chain make up devices.

Automatic spray guns are rigidly mounted on the gun cylinder arms which are hydraulically powered (via gearbox operated master cylinders). When customers wish to change to articles of varying sizes, adjustment is quickly and easily effected by interchanging or adjusting cam settings to cover gun motion and spraying time. Accurate changes to predetermined spraying angles are made simple by the incorporation of calibrated gun arms and mountings. If, by any chance, the hydraulically operated gun motion is jammed or impeded, a relief valve in the system allows for overloading and no damage is sustained. Furthermore, the hydraulic system readjusts itself without disturbing the gun settings.

The down draught exhaust system is ducted vertically through the centre of the machine, opposite the spraying station. Paint laden air is carried down to the easily removed castor-mounted separator which incorporates an effective system of circular baffles and the exhaust air is then taken up and out to atmosphere. The basic machine, including one gun motion and brackets, 16 spindles, one dry separator and exhaust hood, air hose and valves, costs £1,250 0s. 0d. net.

Extra gun motions can be fitted at a price of £115 each net, extra. An additional spraying station costs £255 net, extra, and if required a water wash exhaust system can be provided at an extra price of £100 net, per station. Centrifugal type exhaust fans with necessary ducting, paint supply system and workholders are all available as extras.

A mechanical memory device is available as an optional extra. This automatically signals the machine when workholders are loaded or not and thus provides

a flameproof paint-saving device, also preventing unloaded workholders from being painted.

A machine can be supplied with either 25 ft of chain or a floor mounted conveyor for transportation to an unloading station where air drying materials are used, or a stoving oven. Infinitely variable speed drives are also available. Any combination of these alternatives can be built into a standard unit at extra cost. Stoving ovens can be gas or electrically heated to suit customers' requirements.

Circle **33** *for further details.*

Contact Making Electrostatic Voltmeter

NALDER BROS. & THOMPSON LTD. have now developed a contact making electrostatic voltmeter.

Electrostatic voltmeters are essentially r.m.s. voltage measuring devices which do not rely upon measuring current in a resistor and are, therefore, independent of temperature coefficients.

In the past these instruments have generally been regarded as deficient in torque-weight ratio, damping, and susceptibility to interference from external electric fields. These deficiencies have been recognised in the specification "British Standard 89" which permits wider tolerances for this type of instrument than for others.

In the development of Nalder's new series of electrostatic voltmeters they have produced such instruments with performances more nearly approaching those theoretically possible.

Three applications involving the use of this new instrument cover:

1. Monitoring battery circuits where a relatively high voltage (500 V) must be maintained and no measurable load can be tolerated
2. For high voltage testing of capacitors to a predetermined voltage
3. For use as earth leakage indicators and relays for fully insulated distribution systems, either d.c. or a.c., single- or three-phase.

The instrument contacts, which in the case of over- or under-voltage control can be adjusted externally, are relieved from current carrying by incorporating them in the grid circuit of an associated valve amplifier —the main tripping or alarm current being carried by plug-in solenoid relays.

The operational limits of these new instruments are from 100 volts to 15,000 volts.

Circle **34** *for further details.*

Excess Demand Warning System

AN excess demand warning system, which provides a much closer degree of control over the consumption of electrical energy than the conventional maximum demand warning devices, has now been introduced by Ferranti Ltd.

It has been developed primarily for use in plants of the continuously operated type, designed for maximum production, as shut-downs based upon too frequent warnings of approaching maximum demand can seriously affect the quality of the product and the plant's efficiency, quite apart from the loss in production.

The Ferranti excess demand warning system maintains a continuous watch over the energy consumed during each successive demand period and compares it with an ideal load set by the user. The difference between the actual load and the ideal load is displayed on a 6 in. dial indicator and when the energy consumed by the actual load exceeds that of the ideal load by a pre-determined amount a pair or pairs of alarm contacts close.

The discrepancy indicator is a ratiometer type instrument arranged so that the pointer remains on zero when the integrated loads are equal, moves to the left when the actual load is below the ideal load and moves to the right when the actual load kWh or MWh exceeds the ideal load set by the user. The state of the ideal/actual energy consumed can be seen on the discrepancy indicator at any time during each demand period. Hence, depending on the time of viewing and the relevant load conditions, arrangements can be made to shed a percentage of the load.

The operation of the system is based on the principle of binary storage of impulses by a chain of relays. Impulses representing ideal load conditions are obtained from an impulse generator and the corresponding settings of kilowatts or megawatts is shown on a 6 in. dial dynamometer wattmeter, both of these being fed from a voltage stabiliser unit. The user can regulate the kW or MW setting and hence the rate of impulsing by means of a Variac control.

The ideal load impulses received in each demand period are fed into an impulse comparator which compares them with the impulses received from an impulsing meter or summator working from the actual load to be controlled. The difference is displayed on the discrepancy indicator.

Incorporated in the impulse comparator is one or more sets of alarm contacts, which can be made to close when a pre-determined number of excess impulses of actual load over ideal load has been reached. If it is desired, a time switch can be incorporated in the alarm circuit. This time switch operates with the same interval as the tariff time switch but is set five or ten minutes before it.

Resetting of the impulse comparator and discrepancy indicator is effected every 30 minutes—or other demand period—by means of the tariff switch or a time switch set coincidentally with the tariff time switch. Relays and impulsing circuits are designed for working at 50 volts d.c. and a suitable rectifier unit can be supplied.

Although this equipment is intended for giving warning of excess demand, it can easily be adapted for load control purposes, where it is desired to maintain the load steady within close limits set by the user. This can be done by fitting a second set of alarm contacts in the impulse comparator which close when the actual load impulses are below the ideal load impulses by a pre-determined number.

Circle **35** *for further details.*

Power Pack

W. G. PYE & CO. LTD. have recently produced a stabilised power supply unit.

The design has been thoroughly tested over an extensive period of time and stability on all types of load, particularly capacitive loads, is ensured. All components have been carefully chosen for their reliability

under extreme conditions and they are all conservatively rated. The functions of smoothing are carried out by high quality paper condensers and in fact no electrolytic condensers are incorporated throughout the circuit.

A comprehensive range of voltages can be supplied and all d.c. outputs are fully stabilised against supply and load variations. The range includes d.c. outputs from 0 to 500 V, a fixed negative supply of −250 V and a variable negative supply of 0 to −250 V, all containing less than 0·003 V ripple. In addition two separate a.c. supplies, each of 6·3 V at 5 A are provided.

For variations of ±10% in the supply voltage, the stabilised output does not vary by more than ±0·1% for the positive supply and ±0·5% for the negative supply.

Circle **36** *for further details.*

Pressure Transducer

THE Dynisco pressure transducer, Type PT.58, has been specifically designed for the measurement and control of pressure in thermoplastic extrusion processes, and offers the fast response and reliable performance necessary to measure small and rapid pressure fluctuations which can affect the resultant extrusion.

Operating on the strain gauge principle, the instrument is designed to screw into the barrel or die of the machine where the molten polymer is in direct contact with a small diaphragm at the tip of the transducer stem. The motion of the diaphragm is transmitted through an internal push rod to a load carrying plate, thence to four unbonded strain gauges which form a balanced resistance network to provide an output signal proportional to the applied pressure.

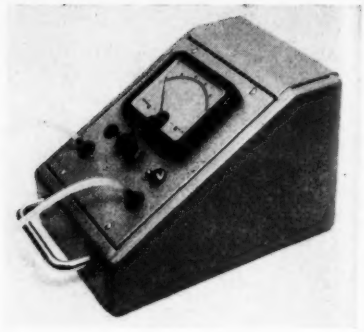
The strain gauge element is protected from high temperature environment at the diaphragm by means of a water cooling jacket which enables melt temperatures up to 750°F to be tolerated. The cooled portion of the transducer is sufficiently distant from the diaphragm to ensure that the melt will not solidify on the pressure sensing surface.

The transducer is supplied in two different standard stem lengths, and is available with intermediate pressure ranges from 0-1,000 to 0-10,000 p.s.i. Similar models for higher pressure ranges up to 40,000 p.s.i. are under development.

The transducer is manufactured by Dynisco Inc. of Cambridge, Massachusetts, U.S.A., whose U.K. agents for sales and technical service are Industrial Instrument Services Co.

Circle **37** *for further details.*

"Dynisco" pressure transducer, Type PT58



Air/gas velocity meter

Air/Gas Velocity Meter

THE air/gas velocity meter developed by The Cobb-Slater Instrument Co. provides both visual indication of air or gas velocity and a full range electrical output which can be used to operate remote indicators, recorders or control systems.

The photograph shows the standard bench type instrument which is suitable for almost any air or gas velocity measurement task and is particularly suitable for ventilation engineering, aerodynamic investigations of velocity distribution, process control involving air or gas flow and meteorological indication and recording of wind speed.

The velocity meter is portable and weighs only 4·5 lb when power is taken from the mains and 6·25 lb when using internal dry batteries. It is robust and will withstand rough handling.

The standard instrument can be calibrated for air velocities from 100 ft/min up to 6,000 ft/min. The ranges of individual instruments are arranged to particular requirements and multi-range instruments can be supplied.

Accuracy can be ±1% of f.s.d. or better depending on the application.

Special instruments which will measure air velocities as low as 30 ft/min can be supplied.

The instrument has a fast response with a time constant of about 1 second.

The mains operated model will accept 210-240 V, 50 c/s, power supply.

The battery operated model 18 V d.c. power supply is taken from internal dry batteries. Replacement batteries can be obtained from most local suppliers.

The standard instrument is used with a Pitot head and static pressure source as are most traditional air speed measuring instruments.

The difference between the Pitot and static pressures is made to induce a flow of air past a heated element so that it is cooled by an amount depending upon the difference between Pitot and static pressures. The temperature of the heated element is measured and an electrical circuit causes the pointer of the indicator unit to indicate the air speed on a calibrated scale.

The flow of air from Pitot to static pressure source is negligible for most purposes since it is only about 150 cm^3/min at maximum velocity in the standard instrument. This leakage can be reduced to about 10 cm^3/min or even less when a larger leakage would be a disadvantage. Because the leakage flow is so small

it is not usually necessary to use pressure pipes of greater than $\frac{3}{16}$ in. bore.

Variations in air temperature are compensated so that the accuracy of the instrument is not affected by temperature variations between −15 and +45°C.

The instrument is sensitive to ambient pressure so that, if required, the mass flow of air or gas passing along a passage or duct can be read directly from a suitably calibrated scale (in lb/min) thus eliminating the need for a separate ambient pressure measurement and correction.

Circle **38** *for further details.*

Transducers

THE high overload low pressure transducer, Type G304, available from Southern Instruments, is an inductance type with provision for water cooling. Displacement of the diaphragm is restricted by a stop which enables the transducer to withstand up to 1,000 p.s.i. The limit of diaphragm movement, and hence maximum output, is attained at a much lower pressure. This transducer is available with any range between 0-10 and 0-100 p.s.i. and it is ideally suited to applications requiring the measurement of low pressures in a system subjected to high shock pressures. The latter have no effect on the range or zero settings.

The pressure transducer, Type G302, is an inductance type with a flush diaphragm. This eliminates the dead volume and passage frequency problem which are associated with a transducer having a retracted diaphragm, and allows mounting without modification of the volume of the medium under test. It can be supplied with any range between 0-10 and 0-10,000 p.s.i. Linearity and hysteresis are better than ±1% of full range. An overload of 100% will not damage the transducer and it will operate at up to 150°C without cooling. It has a high frequency response and can be calibrated statically.

The torsional vibration pick-up, Type G218, has been improved and is now known as the Type G318. There are no slip-rings or moving contacts in this inductance type transducer. The new version is more suitable for high speeds and offers greater dependability under conditions of "run-out" and non-axiality. The output is directly proportional to angular movement in the range ±4°. It can be calibrated under static conditions in the test position using the jig provided.

The pressure transducer, Type G319, completes the group of new transducers from Southern Instruments. It is a capacitance type capable of operating at up to 500°C without cooling.

Circle **39** *for further details.*

Selective Level Measuring Set

THIS set, Type 74194-A, developed by Standard Telephones and Cables, is intended for use on multi-circuit telephone transmission systems at frequencies up to 20 Mc/s. Its selective arrangements are such that two bandwidths are available, one being equal in width to a voice channel and enabling signals to be measured in traffic at inter-supergroup and inter-mastergroup frequencies, and the other being ±100 c/s wide so that low-level signals in voice channels may be measured without interference from adjacent channels or other traffic.

A feature of the set is that when it is used in conjunction with the 74195-A oscillator, automatic tracking is available to keep the frequency of its selectivity circuit in step with the oscillator frequency.

The equipment is mains-operated and is housed in a transportable metal case.

Circle **40** *for further details.*

IBM 1410 Data Processing System

THE IBM 1410 is entirely compatible with the IBM 1401 thus allowing the user of the larger 1401 system to change to the 1410 with the minimum of conversion costs. Furthermore, the 1410 itself may be expanded from a card system to a high speed magnetic tape system, and thence to a system which permits the complete overlap of magnetic tape input/output with processing.

The IBM 1410 card system includes a central processing unit with 10,000, 20,000 or 40,000 positions of core storage and a character cycle of 4·5 microseconds. It may be equipped with one or two data channels. The card read/punch gives card reading of up to 800 cards a minute and a punching speed of up to 250 cards a minute. The new chain printer operates at 600 lines a minute. Blank forms can be skipped at a speed of up to 75 inches a second. An input/output synchroniser allows independent operation of the central processing unit and of input/output devices. The console includes a typewriter for logging manual input, error messages and exceptional output. There is also a paper tape reader, reading five or eight channel paper tape at a speed of 500 characters per second.

The 1410 card system can be enlarged by the addition of up to ten magnetic tape units with each data channel. Three models of tape units are available; all models are compatible; all models have two densities of recording, namely 200 or 556 characters an inch. The three models are:

Model 729 II or IV, with a tape speed of 75 inches and 112·5 inches per second respectively.

Model 7330, a new low-cost tape unit with a tape speed of 36 inches a second.

Up to five IBM 1405 disc storage units, each with a capacity of ten or twenty million characters of information, can be attached to the system's data transmission channels. One of these units may also be used with the IBM 1401 system. Data is read and recorded at a rate of 22,500 characters a second and access time to any record is from 100 to 800 milliseconds.

Reading or writing can take place for one or five records at a time. The disc can thus be loaded from or unloaded on to magnetic tape at a speed comparable with that of reading or writing the same information direct on magnetic tape.

A basic Autocoder system for programming is available together with such advanced programming systems as FORTRAN and Full Autocoder.

The IBM 1410 card system occupies approximately 500 square feet of space and is available from about £119,000.

Circle **41** *for further details.*

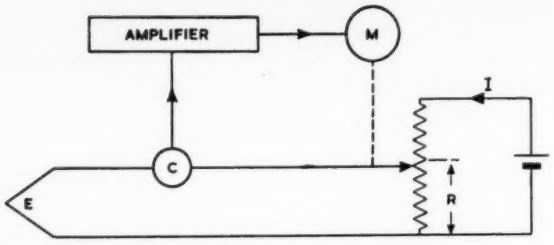


Fig. 1. Simplified diagram of conventional slide-wire potentiometric recorder
C—conventional chopper
M—two-phase motor
R—slide-wire

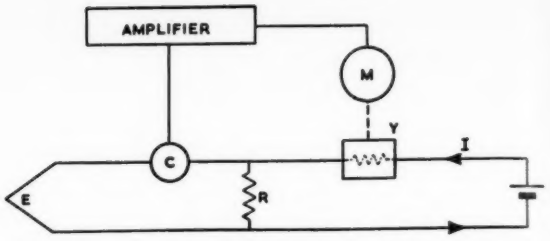


Fig. 2. Simplified diagram of new potentiometric recorder
C—conventional chopper
M—two-phase motor
Y—current controller
R—fixed resistor

New Potentiometric Recorders

SMITHS INDUSTRIAL DIVISION recently introduced a series of new potentiometric recorders. These have been designed by Kelvin Hughes for continuous duty applications in industry and for laboratory investigations in research establishments.

The main feature of the system is that no slide-wire is used; a primary source of wear and loss of accuracy has thus been dispensed with.

The instrument, therefore, differs fundamentally in its principle of operation from the conventional type of potentiometric recorder. This is illustrated by comparing simplified circuit diagrams of the new recorder with that of the conventional instrument (Fig. 1 and 2). In Fig. 2 the slide-wire is seen to have been replaced by a fixed resistor R, the element Y being a current controlling device; as in Fig. 1, the null detector C (a conventional chopper) feeds an amplifier which drives the usual two-phase motor M, which is mechanically coupled to the controller Y. The equation $E=IR$ is satisfied when the null point has been reached, but in this case it is the resistance R which is kept constant, and the current I is varied to suit requirements.

In order that the unit Y may function as desired, it must be capable of controlling the current I in linear proportion to the mechanical input signals or movements imposed on it by the motor M, the controlled current value being unaffected by changes in voltage, temperature or circuit resistance. Though this might appear to be a difficult requirement to meet, units which perform this function are available as mechanical/electric transducers for attachment to pressure or flow measuring elements. Working on the force balance principle, they give a linear current output in proportion to a force or deflection applied to them. They consist basically of a moving coil device associated with a permanent magnet and fitted with some form of positional deflecting device (conveniently a light beam and photocell). In some cases, however, a contact which controls the current through the coil may be used so that if a deflectional force is applied to the coil an increased current through it results, producing an equal and opposite force.

The servomotor produces the linear force by winding up a spiral spring which applies a deflective force to the coil, causing increased exposure of a cadmium sulphide photocell; the increase in current is in direct proportion to the deflection imparted by the motor. In this system the force generated by the spring is balanced against the electro-magnetic force, the forces being equally stable. Any possible change in the characteristic of the photocell or circuit resistance does not affect the measurement within certain limits.

The measurement is of infinite resolution; there are no wiping contacts. The system is inherently stable and needs no standardising. The secondary circuit generates a current which is linearly proportional to the measured variable; as this circuit is not sensitive to changes in resistance, this current may be used for control purposes.

The recorder is designed for up to 12 input channels, each channel being cyclically switched at 5 second intervals. Provision is made for range changing and set-up zero. The rotating balance shaft can carry up to three cams which will operate separately adjustable microswitches for control purposes. The instrument is designed to measure and record small d.c. outputs as obtained from thermocouples, resistance thermometers, resistance strain gauges and other transducers. The minimum input range is 0 to 1 mV.

Circle **42** *for further details.*

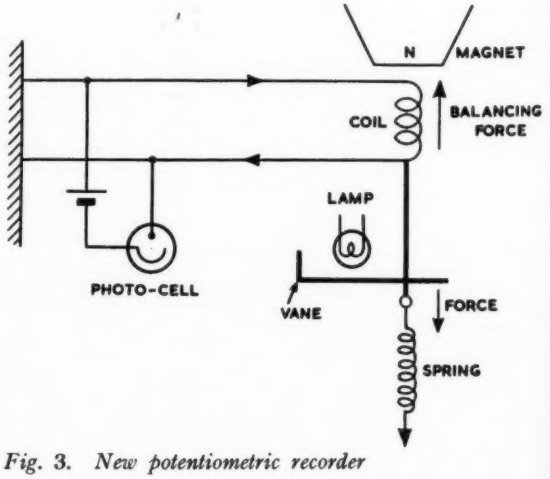


Fig. 3. New potentiometric recorder

"Metox" Miniature Oxide Resistors

WELWYN ELECTRIC LTD. have developed and are now marketing a new range of metal oxide resistors.

The resistors are manufactured and selected in such a way that throughout their life their resistance will always be within the range guaranteed by the suppliers. This is called by the company "The Total Excursion Concept". The maximum deviation from the nominal resistance value (Total Excursion) is specified for a period of up to three years' continuous operation at full load under normal conditions of use.

For the total excursion type resistors three-colour-band coding is applied to one end of the resistors to indicate the ohmic value, and a two-band colour coding is applied to the other end of the resistors to indicate the total excursion.

For the normal selection tolerance type resistors the convention for colour coded resistors is used; four-colour-band coding is applied to one end of the resistors. The first three colours indicate the ohmic value, and the fourth colour indicates the selection tolerance.

The available selection tolerances are ±5% on values 10 Ω to 270 kΩ in all sizes, and ±10% on values 1 Ω to 8·2 Ω on all sizes.

Ratings and Ranges of Total Excursion Miniature Oxide Resistors

Type	Rating at 40°C	Ohmic Range	Max. Voltage	Insulation Strength
F20	½ watt	10Ω -270 kΩ	350 V	1000 V
F22 F22A	1 watt	10Ω -270 kΩ	500 V	1000 V 500 V
F23 F23A	2 watts	10Ω -270 kΩ	750 V	1000 V 500 V

Total Excursion Tolerances

F20	±5% T.E. 47Ω -270 kΩ	and	±7% T.E. 10Ω-270 kΩ
F22 F22A	±7% T.E. 47Ω -270 kΩ	and	±10% T.E. 10Ω-270 kΩ
F23 F23A	±7% T.E. 47Ω -270 kΩ	and	±10% T.E. 10Ω-270 kΩ

The appropriate total excursion specifies, for a period of up to three years (over 26,000 hours), the maximum deviation from the nominal resistance value of "Metox" miniature oxide resistors dissipating up to full-load power continuously in ambient temperatures between 0-40°C and relative-humidities not exceeding 80%.

In any production batch, however, the values and direction of the parameters which are embraced by total excursion are subject to statistical variation. As these parameters are unlikely all to be on the maximum limit and in the same direction at any one time, the majority of the resistors in a batch will always lie well within the permissible total excursion limits.

Circle **43** *for further details.*

Silicon n-p-n Diffused Junction Power Transistors

SEMICONDUCTOR Department of A.E.I. Radio and Electronic Components Division have introduced three Ediswan Mazda n-p-n diffused junction type devices. Types XC703, XC713 and XC723 are intended for a wide variety of industrial applications in equipment operating at temperatures ranging from −65 to +175°C. They are particularly useful in power-switching circuits, oscillator regulator and pulse amplifier circuits, and as Class A and Class B push-pull audio and servo amplifiers.

They are characterised by an extremely low saturation resistance, high current and power dissipation ratings, high Beta at high current, and excellent high temperature performance up to +175°C. At 100°C they offer a range of dissipation of from 2 to 30 watts. They are available in standard JEDEC cans.

Tentative Data

XC703. Maximum collector/base voltage, 60 V; maximum collector current, 1·5 A; maximum total dissipation at case temperature of 100°C, 2 W. *Switching characteristics:* Static current amplification d.c. (d.c. V_{ce}=4 V, I_c = 200 mA), 15 (min) 75 (max); collector/emitter saturation resistance d.c. (d.c. I_c = 200 mA, I_b = 20 mA), 7 ohms (max).

XC713. Maximum collector/base voltage, 60 V; maximum collector current, 3 A; maximum total dissipation at case temperature of 100°C, 7·5 W. *Switching characteristics:* Static current amplification d.c. (d.c. V_{ce} = 4 V, I_c = 750 mA), 15 (min) 75 (max); collector/emitter saturation resistance d.c. (d.c. I_c = 750 mA, I_b = 75 mA), 2·67 ohms (max).

XC723. Maximum collector/base voltage, 60 V; maximum collector current, 6 A; maximum total dissipation at mounting flange temperature of 100°C, 30 W. *Switching characteristics:* Static current amplification d.c. (d.c. V_{ce} = 4 V, I_c = 1·5 A), 10 (min) 50 (max); collector/emitter saturation resistance d.c. (d.c. I_c = 1·5 A, I_b = 300 mA), 2 ohms (max).

Circle **44** *for further details.*

Careers in the Scientific Instrument Industry.

Scientific Instrument Manufacturers' Association. 20 pp. Gratis.

It is essential that the British instrument industry receives a steadily increasing flow of young men and women to become expert craftsmen in the industry's wide range of branches.

To encourage this flow, the Scientific Instrument Manufacturers' Association, 20 Queen Anne Street, W.1, has, therefore, published "Careers in the Scientific Instrument Industry", which gives a summary of what a new entrant into the industry can expect to find and what his work and training may be like.

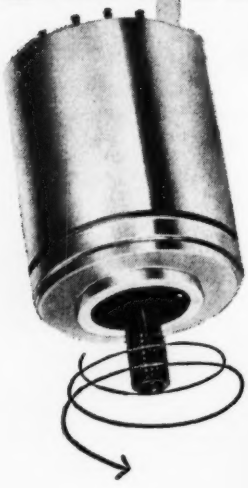
The accent is on illustrations rather than the printed word, but enough of the latter is present to emphasise the attractions of the industry, and the brochure is careful to point out the possibilities of posts at the higher levels.

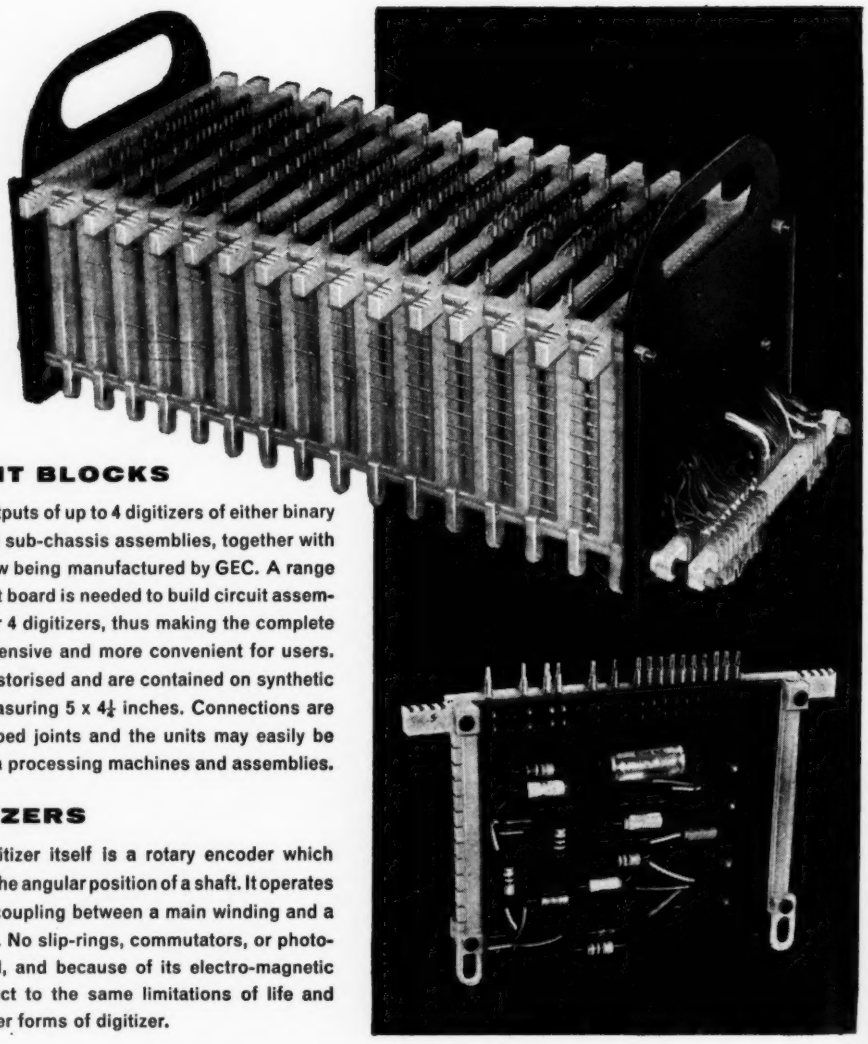
The illustrations are selected to indicate the wide nature of instrumentation manufactured by the industry and to assist further an intending entrant a list of SIMA members grouped according to counties is included.

Circle 114 for further information

G.E.C.

Standard Read Circuits for INDUCTION DIGITIZER SYSTEMS





STANDARD CIRCUIT BLOCKS

In order to present the outputs of up to 4 digitizers of either binary or decimal type, standard sub-chassis assemblies, together with decimal decoders are now being manufactured by GEC. A range of only five types of circuit board is needed to build circuit assemblies for reading 1, 2, 3 or 4 digitizers, thus making the complete equipment both less expensive and more convenient for users. The circuits are all transistorised and are contained on synthetic resin-bonded boards measuring 5 x 4½ inches. Connections are made by means of wrapped joints and the units may easily be integrated into larger data processing machines and assemblies.

INDUCTION DIGITIZERS

The GEC. induction digitizer itself is a rotary encoder which gives a representation of the angular position of a shaft. It operates by varying the inductive coupling between a main winding and a number of digit windings. No slip-rings, commutators, or photo-electric devices are used, and because of its electro-magnetic operation it is not subject to the same limitations of life and environment as most other forms of digitizer.

G.E.C.

For further information, please write to:

THE GENERAL ELECTRIC COMPANY LIMITED OF ENGLAND

ELECTRONICS DIVISION · LOWER FORD STREET · COVENTRY · ENGLAND

Smee's GEC 70

NEWS OF THE INDUSTRY

INSTRUMENTS

LIVINGSTON LABORATORIES announce that **Tektronix oscilloscopes** are now being manufactured in Guernsey. Models to qualify under Commonwealth Preference regulations are Types 515A and 545A, together with a wide range of plug-in units. These precision oscilloscopes are now available to engineers in Britain and the Commonwealth, without the problem of obtaining duty remission.

Additions to the Tektronix range being produced in Guernsey will be announced over the next few months.

IMPROVED production techniques have enabled A.E.I. Radio and Electronic Components Division to reduce the prices of new and reconditioned **Ediswan Mazda cathode ray tubes.** The new prices are effective from 5th December, 1960.

Prices of tubes have been reduced by £1 10s. (from £16 to £14 10s.) in the case of the two latest 21 in. 110 degree deflection tubes, types CME2101 and CME2104, and by 15s. (from £12 10s. to £11 15s.) on the 17 in. 110 degree Types CME1703 and CME1705.

In the Extra Life range of reconditioned tubes the maximum cut is £2 3s. 4d. (from £14 13s. 4d. to £12 10s.) on three 21 in. tubes, the CRM211, CRM212 and CME2101, while the 17 in. types are reduced by £1 6s. 8d. (from £11 6s. 8d. to £10).

MR. PHILLIP H. EMRICH, training systems manager of the Western Design Division of U.S. Industries Inc., has been reviewing the market potential and considering marketing approach in this country for Western Design's new Mark II **Auto-Tutor,** which has been specifically designed for classroom use and specialised teaching and training situations. The Mark I AutoTutor, a new kind of automatic teaching machine, was shown for the first time in Britain at last year's Instruments, Electronics and Automation Exhibition.

He has also been reviewing the manufacturing and engineering capabilities of Burtonwood Engineering Company, which was acquired in October, 1959, by U.S.I.'s British subsidiary, U.S. Industries Inc. (Great Britain) Limited, and which it is planned will manufacture the new television size Mark II AutoTutor.

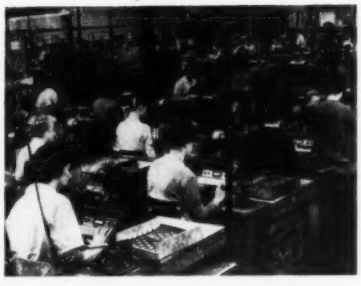
The new AutoTutor incorporates two innovations in the field of mechanical teaching devices.

While requiring the student to show understanding at each step of the course, the machine lets him advance as slowly or as rapidly as he is able. At the same time, it automatically records his progress and charts his reasoning process.

In operation, when the student sets up the machine, which looks like a portable television set, he sees a page of information, including pictures or diagrams, on an 8 in. × 11 in. screen. After studying the material, the student must answer a multiple-choice question on what he has read.

To answer, he punches a lettered button on a single row keyboard. On his screen, a new page of information either (a) verifies his answers and proceeds with the course, or (b) explains his error and directs him to select another answer. Moving picture sequences, available on Mark I, have been eliminated on Mark II for reasons of cost. The student's errors are automatically recorded for analysis by instructors.

Advantages are that, treating the student as an intelligent human being, the AutoTutor advances him at a rate determined by his own ability, frees the teacher for creative work, records progress of the trainee and provides a record of the individual's approach and reasoning process.



HI-FI and other post-war advances in sound recording techniques have created a demand for higher standards of performance in sound reproducing mechanisms.

Birmingham Sound Reproducers Ltd. has met this challenge by installing 30 **dynamic balancing machines,** *made by E.M.I. Electronics Ltd., at its factories at Old Hill, Staffordshire, and Londonderry.*

E.M.I. balancing machines balance the rotors to an accuracy of 10 *milligrams at a radius of one centimetre and the machines can be operated by semi-skilled girls after training.*

FURZEHILL LABORATORIES LIMITED have taken over the production, sales and service of the range of **stroboscopes** previously manufactured by Watford Instruments under the trade name of STROBOLYSER.

A new range of standard STROBOLYSERS will be introduced and a special stroboscopic department has been created to maintain the previous facilities for the production of equipment for special applications.

Mr. Paul D. Tyers, who has been responsible for many developments in the stroboscopic field, will continue to be associated with the design of the new Furzehill "Strobolysers".

SUBSTANTIAL reductions in the prices of their entire range of **Norbit electronic sub-assemblies** are announced by Mullard Equipment Ltd.

The cuts range from 42% to 23%. A complete counter chassis, for example, is reduced by £6 to £19 10s. 0d., while the basic Norbit switching unit is down by 11s. 8d. to 30s. 0d.

JOSEPH WEIL & SON LTD. are now able to offer semi-manufactured **products of polytetrafluoroethylene** (p.t.f.e.). These are produced by their principals, Marengo S.p.A. from "Algoflon", the registered name of the p.t.f.e. manufactured by the Italian firm Montecatini.

COMPANIES

THE **M.T.E. Control Gear Ltd.** factory extension increases by one-third the productive floor space and office accommodation. Within the next two years further extensions will again increase the total floor area.

Since its formation, in small premises at Whittlesea, Cambridgeshire, in 1946, M.T.E. steadily became established in the field of control gear manufacture, supplying custom built control panels for a wide variety of industrial applications.

Concurrently, M.T.E. were developing the "Discmag" range of electro-magnetic a.c. disc type brakes which have since been adopted as standard by many large manufacturers of electric motors.

The latest new product released by the company is their UNICONTROL system. Designed for programming and sequencing applications, the unit incorporates a heavy duty uniselector with plug-in arrangements on all contacts and a patented load switching circuit which permits direct switching of solenoids and contactors without the use of a number of slave relays. Change of programme or complete replacement of this standardised unit can be achieved in a matter of seconds.

AN advanced technical-development unit is to be formed at Abingdon by **Quickfit and Quartz Ltd.,** manufacturers of interchangeable laboratory glassware.

Manager of the new division will be Mr. R. N. Jukes, who has previously been responsible for design of laboratory apparatus at the Stone (Staffordshire) factory.

Quickfit hope to have the unit operational in premises at Ock Mill, Abingdon Berks., by next spring.

Johnson, Matthey & Co. Ltd. have acquired a controlling interest in the Swedish precious metal company A/B Gösta Nyström, of Stockholm. Mr. Gösta Nyström, who founded the business in 1917, has retired and a new board has been appointed consisting of four Swedish and two British directors, with Mr. Ove Trulsson as chairman.

A/B Gösta Nyström supply precious metal products for all industrial purposes as well as for jewellery, silversmithing and dental requirements. Since 1932 they have acted as agents in Sweden for some of the products of Johnson Matthey.

The company will in future be known as A/B Nyström & Matthey.

On 8th December, 1960, the Leeds and Northrup Company of Philadelphia acquired all the outstanding shares not previously owned by it in **Integra, Leeds and Northrup Ltd.,** which latter company on the same day changed its name to **Leeds and Northrup Ltd.**

It is the intention of the parent company to supply substantial additional capital to enable the company to build new works and offices and embark on a programme of development and expansion of its present plant and equipment to take advantage of the widening market in Great Britain for its production of electronic measuring and control instruments and heat treatment furnaces.

Mr. J. W. Robinson, until recently president of Leeds and Northrup, Canada, Ltd., will join Mr. J. J. A. Rogister as joint managing director.

E.M.I. Electronics Ltd. has created, within its present Publicity Organisation, a special Export Publicity Department which will handle every aspect of export sales promotion including overseas public relations, advertising, exhibitions, mobile demonstrations, multi-language literature, and direct mail.

Mr. R. W. Addie, marketing director of E.M.I. Electronics Ltd., said that E.M.I. are aiming at a ratio of 60%-40% in favour of export sales of their products.

New export publicity officer is A. J. Spicer, who takes up the appointment after a period of training with E.M.I. Electronics.

The Mayor of Chatham, Ontario, recently opened the new $M\frac{1}{4}$ production plant of the newly-formed company, **Parkinson Cowan (Canada) Ltd.**

Mayor Garnet Newkirk, of Chatham, Ontario, cuts the tape to open the first Parkinson Cowan factory in Canada

This factory, the first to be opened by Parkinson Cowan in Canada, occupies a five-acre site and will initially employ only a small labour force. The number of staff will build up gradually over the next five years until production has diversified and extended to include many of the wide range of P.C. products made in the U.K.

The chairman of Parkinson Cowan, Mr. Hugh P. Barker, was unable to attend the factory opening personally but sent a recorded message in which he expressed the strong conviction that Canada would soon become "the economic centre of the Commonwealth".

A Canadian, Mr. Denis Bach, is general manager of the new factory.

Mr. Richard Foxwell, managing director, and Mr. Gordon Ball, general sales manager of **Wayne Kerr Laboratories,** have been visiting the United States to discuss with their American company in Philadelphia, promotion plans for 1961, and in particular the introduction of their transfer function computer to the American market at the I.R.E. Show, New York, in March. Visits will also be paid to their other representatives in U.S.

Sales in America represent an important proportion of Wayne Kerr exports. Total exports account for more than 40% of their production of instruments in the United Kingdom.

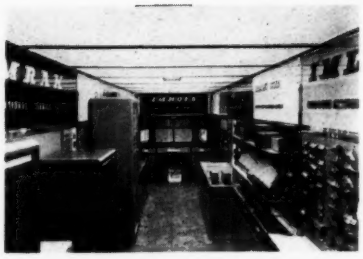
The services provided by Welding Supervision Ltd. and Cathodic Corrosion Control Ltd. (wholly owned subsidiaries of Constructors John Brown Ltd.) have been amalgamated and will now be provided by a single company—**Corrosion and Welding Engineering Ltd.**

The directors will be:

Messrs. R. M. Wynne-Edwards
C. C. Bates
R. A. Lowe
H. M. Powell
J. A. R. Staniforth
H. D. Walker.

The Firth Cleveland Group have acquired the lease of 7 Cleveland Row, St. James's, London, S.W.1, a large block adjacent to the Group's Headquarters at Stornoway House, Cleveland Row. 7 Cleveland Row, St. James's, will now house: Home Sales Offices, Water Separator Division, Simmonds Aerocessories Ltd.; Technical Liaison, Simmonds Aerocessories Ltd.; Home Sales Offices, Firth Cleveland Instruments Ltd.; Home Sales Offices, Surform Division, Firth Cleveland Tools Ltd.; Home Sales Offices, Spire Speed Nut Division, Simmonds Aerocessories Ltd.; London Area Manager, Industrial Nut Division, Simmonds Aerocessories Ltd.; Southern Area Manager, Spire Speed Nut Division, Simmonds Aerocessories Ltd.; Head and Sales Offices, British Lead Mills Ltd.; Head and Sales Offices, Seculate Ltd.; General Sales Office, Richard Hill Ltd.; London Design Officer, Richard Hill Ltd.

Stornoway House will now house: London Sales Office, The Firth Co. Ltd. and will continue to house: Firth Cleveland Ltd., all Departments; Firth Cleveland Pumps Ltd., Sales Offices; Simmonds Aerocessories Ltd., Export Sales Offices; Firth Cleveland Instruments Ltd., Export Sales Offices; Landmaster Ltd., Export Sales Offices.



This trailer van with a Lumitron illuminated ceiling has been specially constructed for Imhofs as a mobile showroom to display their metal cases, racks, housings and cabinets for electronic gear and equipment

The Automatic Control Division of **Constructors John Brown Ltd.** has been formed into a wholly owned subsidiary company, **Automatic Control Engineering Ltd.**

The services previously provided by the Division to industry at home and overseas will be continued and developed by the new company. These services include consultancy design, works assembly and site installation in the fields of:

Instrumentation
Automatic Control
Remote Control and Telecommunications
Laboratory Engineering.

As before, the role of the new company will continue to be that of an independent engineering service supported by a Research and Development team for the provision of efficient and economic instrumentation and automatic control systems.

The directors of Automatic Control Engineering Limited will be:

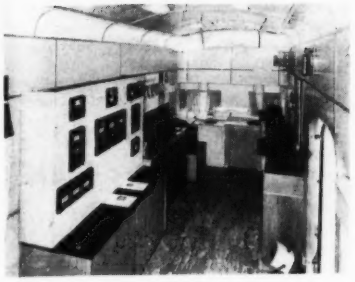
I. J. Crosthwaite, D.S.O. (Chairman)
H. D. Walker, M.I.Mech.E., M.Inst.Pet.
R. Riley, B.Sc.(Eng.), A.C.G.I., M.I.Mech.E.
H. H. Rosenbrock, B.Sc.(Eng.), Ph.D., M.I.E.E.
M. P. Atkinson, B.Eng.

Mr. R. Riley will also hold the position of general manager and Mr. M. P. Atkinson that of chief engineer.

The address is:

Automatic Control Engineering Ltd.,
Roxby Place,
Seagrave Road, London, S.W.6.

Commander P. W. Kent, R.N., chairman of **George Kent Ltd.,** presided at the company's 1960 annual long-service presentations. The ceremony not only marked the 25th anniversary of the inauguration of the scheme by the late Sir Walter Kent, but was made doubly significant by the fact that the recipients' total service amounted to 1,095 years—a record figure. Included in the 41 certificates altogether awarded this year were one for 45 years', and two for fifty years' service. One of the several Board members in attendance, Mr. R. S. Medlock, Research and Engineering Director, himself received a 25-year certificate.



A.E.I. Instrumentation Division's mobile exhibition

AEI Instrumentation Division's mobile exhibition unit, displaying a range of drawout relays recently developed by the Instrument and Meter Department at Trafford Park, has recently completed an extensive tour of Great Britain.

Starting on 4th October in the North West, the unit has visited the C.E.G.B., Electricity Boards and switchgear manufacturers throughout the North West, the Midlands, South Wales, and North Eastern England. Under the guidance of AEI Regional Engineers, it has completed a tight programme of visits and has been seen by over 900 technical personnel.

Sifam Electrical Instruments Co. Ltd. recently opened new factory premises at Woodland Road, Torquay, Devon.

The new factory has a total floor area of 21,000 square feet and can accommodate 260 employees. The complete manufacturing unit has been designed and built for the manufacture of electrical measuring instruments and pyrometers and carrying out associated research and development work.

All parts used in the clean areas pass through a semi-clean area where they are ultrasonically cleaned or blown clean by compressed air, before being placed in polythene containers. They are then passed to the clean area through electrically interlocked double hatches having slight outward pressure.

The personnel in this final area use separate entrances and changing rooms, and are clothed only in nylon and terylene, including hats, undergarments and special footwear.

The saving in time previously lost by multiple inspection for, and removal of, foreign particles more than compensates for the trouble taken to promote these special conditions. The seating, lighting, benches, flooring, etc., are all specifically designed for this clean area, and a separate air-conditioned, short-break canteen is provided for the operators.

THE mobile showroom of **Parkinson Cowan Measurement** has now travelled 6,000 miles since first taking to the road less than a year ago. It has completed eleven scheduled tours.

Among its stopping places have been breweries, water authorities, chemical engineers, paper mills, universities, food manufacturers, in fact almost every type of establishment interested in measuring or dispensing fluid.

Displays inside the showroom include working and sectionalised models of water meters, liquid food meters, variable stroke pumps, an oil meter with a resettable index and a complete control panel which demonstrates several Parkinson Cowan Measurement systems of dispensing liquid in batches.

Also to be seen in a working demonstration is a Unipulse meter dispensing quantities as small as 0·01 of a gallon. The range of this meter is 0–300 gal/h with an accuracy of 0·25%.

The showroom is entirely self-contained with its own 1½ kW generator and has facilities for storing the different fluids used in demonstrations.

EMPLOYEES of the **Griffin & George Group** who have completed 40-49 years of service with the company with the gold watches they received from Mrs. Gordon Sinclair, wife of the chairman of the Group, during the recent Annual Dinner and Dance at the Waldorf Hotel, London.

To give better service to Scottish Industry, **Bowthorpe Electric Co. Ltd.**, in association with Line Equipment Ltd., have established a new distribution branch at 32 Woodville Street, Glasgow, S.W.1.

Appointed as branch manager is Mr. W. Allan.

Bowthorpe House will stock a comprehensive range of the companies' products, and orders from the Scottish region should be sent to this address.

The telephone number is GOVAN 3681/2 and telegraphic addresses are—"Bowthorpe—Glasgow" and "Linequip—Glasgow."

THE **Electrical Research Association** now has new offices at Cleeve Road, Leatherhead, Surrey. Telephone: Leatherhead 4151.

CONTRACTS

Lancashire Dynamo & Crypto has received an order from Fairey Engineering, sub-contracting to Atomic Power Constructions, for nearly 400 permanent magnet motors for operating the reactor control rods of the Trawsfynydd nuclear power station.

The motors will be Class "H" insulated to operate in an ambient temperature of approximately 100°C, and will be operated from a variable frequency supply so as to have a final speed between 0·2 r.p.m. and 0·7 r.p.m.

BORDER TELEVISION LTD., who will provide the Independent Television Programme for over half a million people in the English and Scottish border area, from a TV centre at Carlisle, has placed a contract with **E.M.I. Electronics Ltd.** for all its vision, sound and control equipment and for the supply from other manufacturers of all lighting and ancillary equipment.

The principal items of equipment include:

Three vidicon camera channels and all associated sound and vision equipment for a main studio; complete presentation studio equipment, including one camera channel; three sets of telecine equipment, each including facilities for projecting 16 mm and 35 mm films and slides; appropriate caption and station clock equipment; studio control equipment for the main studio; master control equipment for the complete centre; lighting equipment; film cameras and film handling equipment; camera mounting equipment.

E.M.I. Electronics will also be responsible for the wiring and installation of all the electronic equipment in the Centre.

The Carlisle TV Centre is similar in size to many proposed overseas TV stations, the requirements of which are completely met by the type of installation which has been designed by Border Television and E.M.I. over a period of several months.

The service is scheduled to start early in September, 1961.

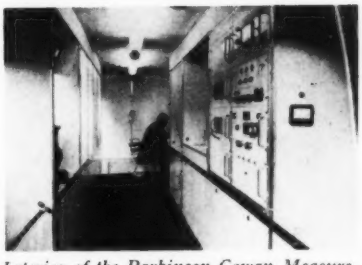
A LICENSING agreement for the manufacture and sale in the United Kingdom and Eire of nuclear research and training reactors has been concluded between **American Machine and Foundry Company,** U.S.A., and **Pye Ltd.,** of Cambridge. This was jointly announced by Mr. Morehead Patterson, AMF board chairman, and Mr. C. O. Stanley, Pye Ltd. chairman.

Under the terms of the contract Pye will make available to U.K. universities, hospitals and research centres a fully developed and widely used series of low-power reactors and related equipment as well as design and engineering services. The agreement also anticipates the extension of AMF-Pye co-operation in the nuclear field throughout the British Commonwealth as well as Iraq, Jordan and Egypt.

Wild-Barfield Electric Furnaces Ltd. have received an order from Messrs. L. H. Newton Ltd., of Birmingham, for a continuous shaker hearth furnace installation.

The equipment will be charged automatically and work untouched by operators as it is progressed through hardening, quenching, washing, tempering and final quenching for delivery into collecting baskets at the rate of 600 lb/h. Hand adjustments will be provided to enable certain work to be diverted after quenching and before entering the washing equipment.

Initial charging will be carried out by means of a vibratory feeder, and progress through the hardening and tempering furnaces will be by twin shaker hearth trays. Belt-type extractors will be employed to remove work from the quench tanks.



Interior of the Parkinson Cowan Measurement mobile showroom

Both furnace chambers will be provided with an endothermic atmosphere and automatic temperature control. Oil in the quench tanks will be violently agitated and its overheating will be prevented by the use of thermostats controlling coolers and circulating pumps.

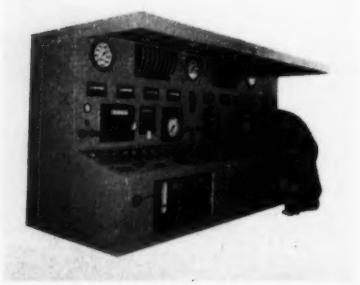
Marconi Instruments Ltd. has received contracts worth approximately £100,000 from Supreme Headquarters Allied Powers Europe for telecommunications test gear to be used on the "Ace High" project.

Included in the contracts are quantities of white noise test sets, signal generators covering both the v.h.f. and u.h.f. bands, and universal bridges.

The white noise test set permits realistic measurement of intermodulation products and noise in multi-channel systems by the noise-in-slot technique. Its test signal simulates busy traffic conditions in the multi-channel bandwidth of the link.

Each test set comprises a noise generator, band-stop filter unit, and receiver. The generator and band-stop filter unit provide the input to the equipment, or link, under test; the output is applied to the receiver. By switching a band-stop filter into circuit and using the receiver to determine the drop in noise level within the stop band, the ratio is obtained of (i) the portion of the noise representing a multi-channel signal falling within the receiver bandwidth, to (ii) the noise remaining in the same bandwidth when the applied signal is suppressed over the stop band. This ratio, called the "noise-power ratio", is a measure of the intermodulation products, and inherent noise, in the stop band when the remaining channels are carrying signals.

George Kent Ltd. recently despatched from their Biscot Road, Luton, works, the largest single-section instrument and automatic - control panel ever manufactured by the company. This cabin-type panel, measuring approximately 16 ft long, 8 ft high and 7 ft deep, was supplied to the order of Babcock and Wilcox Ltd. for the South African Electricity Supply Commission's Hex River Power Station, for which a considerable amount of other Kent equipment is being supplied. Wholly assembled complete with control desk and canopy, the unit was enclosed for transportation in a single large packing case which alone weighed almost four and a half tons.



Single-section Kent instrument and automatic-control panel

An order for several hundred axial flow blowers has been received by **Plannair Ltd.,** of Leatherhead, from **L. M. Ericsson, of Sweden.** They will be used on the temperature control of airfield ground control equipment.

These Type 1 PL 121-378 blowers, weighing six ounces and measuring 3·543 in. long, have a blade tip diameter of 1·3758 in. They are fitted with high precision stainless steel bearings and operate at both very low and very high temperatures at 20,000 r.p.m. from 115 V single-phase at 400 cycles. The blowers, which are specially designed for vigorous conditions and long life, undergo a series of high impact tests at the Plannair factory.

University College, Swansea, Department of Chemical Engineering, have placed an order with **Electronic Associates Ltd.** for a Pace analogue computer of 48 amplifiers. This computer will be the eleventh 0·01% machine to be installed in the United Kingdom and is the first high accuracy instrument ever to be purchased by a British University, and the first to be used on distillation column and other chemical process problems in this country.

AGREEMENTS

Leonard Wadsworth & Co. Ltd. have been appointed the sole agents in the U.K. for the **Secon Metals Corporation,** of New York. Among the products they will be handling will be precision fine wires.

Winston Electronics Ltd., Waring Products Division, Shepperton, Middlesex, have, under their agreement with the **Dynamics Corporation of America,** become the sole marketing agent—and later the British manufacturers—of the Waring series of blenders or mixers. The range covers the extremely popular domestic models which are now immediately available for sale to the public in this country and the larger catering, industrial and hospital blenders and mixers.

Marconi Instruments Ltd., under a recent agreement with **Computer-Measurements Co.,** of Sylmar, California, will manufacture CMC's range of transistored electronic counters. Marconi Instruments will enjoy world selling rights outside North America and Japan.

The agreement covers a 10-year period, and also includes provision for the exchange of engineering information in the field of related transistored products.

Arthur Guinness Son and Co. Ltd. have acquired a controlling interest in **K. G. Corfield Ltd.,** who manufacture Periflex 35 mm precision cameras and other photographic equipment at Ballymoney, Co. Antrim.

The Periflex now has the largest sale of any precision camera made in the United Kingdom. Within the next few years the company hoped to develop other cameras using different film sizes and was investigating the possibility of making ciné cameras.

About 100 Ulster workers at present produce three models of the Periflex Gold Star camera, selling at from £45 to £53 and the Periflex 3a advanced model, selling at £60 to £70 according to lens type. They also make a special 35 mm camera body, the Interplan, which enables a photographer to switch his lens from one apparatus to another and take colour and black and white pictures at the same time without needing two complete cameras. Another product is the Lumimeter, an enlarging exposure meter.

A new Corfield camera, the Periflex 3b, designed for professional use, is coming on the market later this month.

EXHIBITIONS, CONFERENCES, ETC.

The IMEKO International Measurement Conference will be held in Budapest from 25th June to 1st July. Among the topics to be covered by the conference are: theory and practice of instrument design and manufacture; instruments and methods for measuring geometrical, mechanical, thermal, physico-chemical, electric and magnetic quantities, time frequency and radioactive radiation.

Detailed information and invitation to the conference may be obtained from the IMEKO Secretariat, Budapest, P.O.B.3.

The first national **Drawing Office Equipment and Materials Exhibition** in the U.K. is to be held in the Royal Horticultural Society's New Hall, Westminster, from 5th to 8th June, 1961.

The second national **Laboratory Apparatus and Materials Exhibition** will be held in the Royal Horticultural Society's New Hall, Westminster, from 19th to 22nd June, 1961.

Sponsored by *Laboratory Practice*, the exhibition is being held so that manufacturers of apparatus, materials and other products specifically produced for laboratories can show their equipment to scientists and laboratory executives in industry, research, education, medicine and national and municipal government.

The technical programme is now competel for one of the most comprehensive meetings ever held on the subject of temperature measurement. About 200 papers will cover temperature measurements from absolute zero to 10,000,000°K with interests ranging from the temperature of the human body to the temperature of the sun. Almost every area of the physical, biological, and medical sciences will be represented at the **1961 Symposium on "Temperature, Its Measurement and Control in Science and Industry",** to be held in Columbus, Ohio, 27th to 31st March, 1961. The conference is sponsored by the American Institute of Physics, the Instrument Society of America, and the National Bureau of Standards.

Temperature ranks as one of the most important of the physical quantities, and its measurement and understanding have provided some of the most difficult and challenging problems in experimental and theoretical physics. The 200 papers scheduled for presentation come from universities, government and military

research laboratories, and industrial research laboratories in this country, as well as from research centres in Australia, Germany, Netherlands, Canada, Soviet Russia and Great Britain.

The symposium is organised into 16 sessions, devoted to such topics as: Basic Concepts of Temperature, Temperature Scales, Thermocouples, Resistance Thermometers, Gas Thermometers, Spectroscopic Methods, Pyrometry, Miscellaneous Methods, Automatic Methods for Measurement and Control, Measurement in Dynamic Systems, Special Sources of Temperature, Cryogenics, Plasmas, Temperature Measurement in Geophysics, Temperature Measurement in Astrophysics, and Temperature Measurement in Biophysics and Medicine.

Persons interested in the symposium may obtain further information by writing to V. W. Sikora, Instrument Society of America, 313 Sixth Avenue, Pittsburgh, 22, Pennsylvania.

Radio Techniques and Space Research will be the theme of next year's Brit.I.R.E. Convention which will take place from the 5th to 9th July, 1961, at the University of Oxford.

The Convention Committee has invited offers for papers and these, accompanied in the first instance by a synopsis, should be addressed to: The British Institution of Radio Engineers, 9 Bedford Square, London, W.C.1.

The Convention will contain at least six sessions and the scope of the various sessions will cover the following:

Session 1—"Review of the Role of Radio Techniques in Space Research": (Survey papers on the ionosphere, instruments in satellites, deep space aspects and terrestrial communications.)

Session 2—"Satellite Engineering Problems": (Papers on environmental aspects, constructional techniques, component and system reliability, power supplies, etc.)

Session 3—"Extra - terrestrial Measurements": (Papers on, for instance, the measurement of ionic density and upper atmosphere composition, geomagnetic field determination, Faraday rotation, cosmic ray investigations, etc.)

Session 4—"Telemetry": (Papers on coding, bandwidth considerations, frequency allocations, satellite and launcher control, etc.)

Session 5—"Techniques in Radio Astronomy": (Papers on the various types of aerial, low-noise radio receivers, radio aspects of the computational techniques employed, etc.)

Session 6—"Satellites in Terrestrial Communications": (Papers on the systems and circuit engineering aspects of passive and active satellite repeaters and their associated ground receiving stations.)

THE **Second International Conference on Materials Handling,** organised by the Institute of Materials Handling, is to take place in Southport from 10th to 12th May.

Delegates will mostly arrive on the evening of 9th May. Although on the morning of 10th May there is a full programme of visits, the formal opening will be delayed until the afternoon to accommodate those delegates unable to travel before Wednesday morning, after which the delegates will get down to the first plenary session. A civic reception in the evening will precede a banquet incorporating the 8th Annual Dinner of the Institute. The morning of the following day will be spent visiting works and installations within the area.

During the day the four phases, construction, procurement, manufacture and transport and distribution will be examined in relation to the materials handling problems in agriculture and food production, extractive (minerals) and chemical industries and the heavy and light industries.

Brochures may be obtained from the Institute of Materials Handling, 32 Watling Street, London, E.C.4.

THE Mass Spectrometry Panel of the Institute of Petroleum in conjunction with A.S.T.M. Committee E-14 are organising a **Conference of Mass Spectrometry** which is to be held at Oxford University on 12th, 13th and 14th and the morning of the 15th September, 1961.

Papers dealing with any aspect of mass spectrometry will be welcome but special sessions will be held which will deal with high resolution mass spectrometry, the mass spectrometry of organic compounds and the mass spectrometry of inorganic solids.

Authors who wish to present papers at the conference are asked to send full abstracts by 28th February, 1961, to Dr. R. R. Gordon, chairman, Mass Spectrometry Panel, National Coal Board, Coal Research Establishment, Stoke Orchard, Cheltenham, Gloucestershire. The final choice of papers to be presented will be in the hands of a reviewing committee which will make its decision on the basis of the abstracts submitted.

It is intended that preprints of papers shall be sent in advance to all conference members. For this reason complete papers will be required by 31st May, 1961.

THE **Symposium on the Numerical Treatment of Ordinary Differential Equations, Integral and Integro-differential Equations** took place in Rome during the week of 20-24th September, 1960, at the Mathematical Institute of the University of Rome. This symposium was organised by the Provisional International Computation Centre (PICC).

The symposium opened with a report delivered by Professor Walther, of Darmstadt (Germany), on the methods presently employed in the treatment of integral and integro-differential equations. The different methods are classified in categories according to the nature of the problem, the type of solution desired, and the numerical and/or electronic means available. Dr. Genuys (Paris) then presented a second report, also very complete, on the methods of treating ordinary differential equations. Like Professor Walther, Dr. Genuys examined each method in relation to the practical possibilities of processing by modern electronic computers.

After this introduction, more than 50 specialists, divided into three study groups (Section I: Ordinary differential equations; Section II: Integral and integro-differential equations; Section III: Applications), lectured on their personal studies, exposing the particular problems with which they dealt and how the practical and theoretical difficulties which they encountered had been overcome.

The symposium was attended by about 200 mathematicians from the following countries: Austria, Belgium, Czechoslovakia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, the Netherlands, Poland, Rumania, Sweden, Switzerland, United Kingdom, United States of America, Yugoslavia.

Of a more general and philosophic nature was the lecture delivered by Professor Lanczos (Dublin) on the possibilities offered by modern electronic computers, closely allied with a penetrating criticism of the approximation and convergence processes.

The final session was devoted to a speech by Professor R. Courant, of New York, who discussed his personal conclusions on the requirements of scientific research in our highly technical century, as well as the often rather delicate pedagogical problems posed by training, at the highest level, of young specialists in the field of automatic computation.

The *Proceedings*, consisting of about 700 pages will be published by Birkhäuser Verlag (Basel/Stuttgart).

EDUCATION

THE third CoID **design appreciation course** for apprentices and junior engineers will take place in March and April, 1961. It will be held at Reigate in two residential periods, each of four days, separated by an individual study period of four weeks. The cost is 35 guineas for each student, exclusive of travelling.

The residential periods include visits to factories, the Design Centre and schools of industrial design (engineering). In the month of individual study, each student makes a design analysis of two articles seen in the Centre. During the final residential period, these analyses are presented to the class by the student and a detailed criticism is given by one of the Council's Industrial Officers.

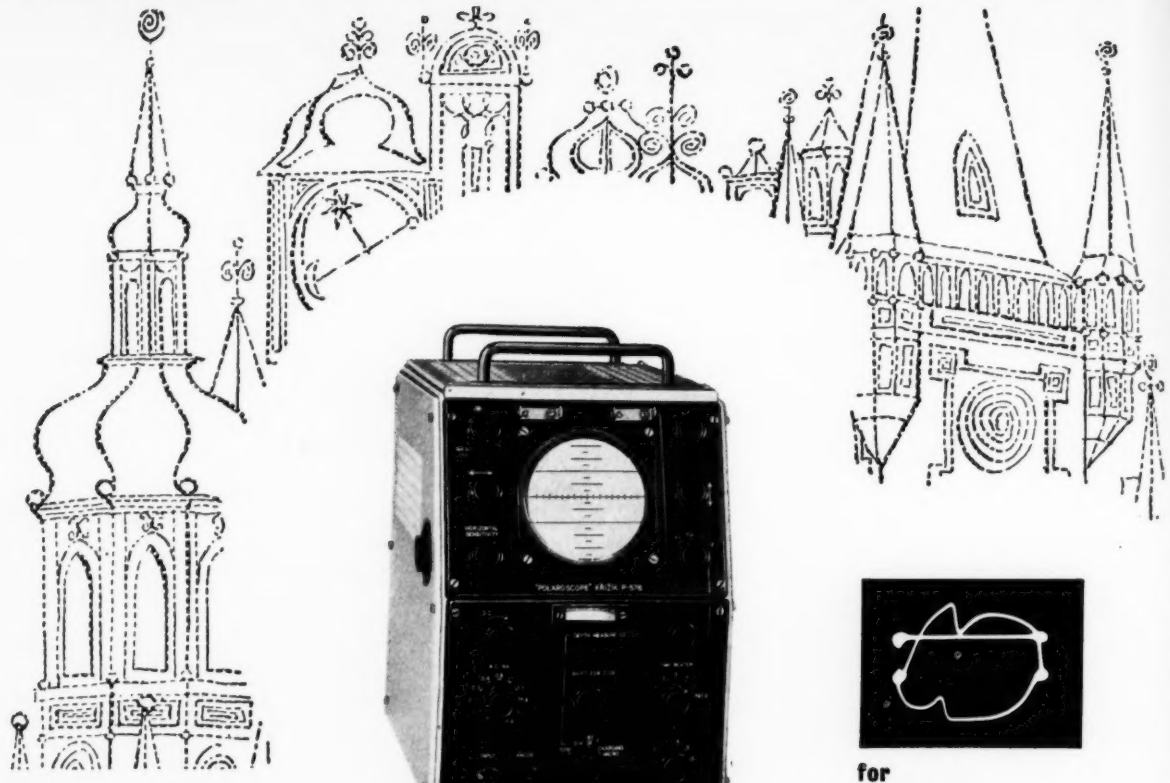
The course is not intended as a short-cut to industrial design. Its aim is rather to increase design appreciation and create an awareness of the industrial designer's place in the factory team.

A detailed programme for the March-April course is not yet available but lectures will probably include Focus on Design; An Outline of Present-day Concepts; Design in Presentation; An Analysis of Design; Human Factors in Design; Form and Composition; and How a Designer Works.

Applications and requests for further information should be addressed to Miss Sydney Foott, Education Section, CoID, 28 Haymarket, S.W.1.

SALFORD ELECTRICAL INSTRUMENTS LTD. are now marketing a unit to demonstrate the **Peltier effect.** Specially designed for use in schools, universities and teaching laboratories, the unit takes advantage of recently-developed materials which greatly enhance the Peltier effect. Previously the effect has been too small to provide a convincing demonstration even with the best chosen combination of metals.

Circle 115 for further information



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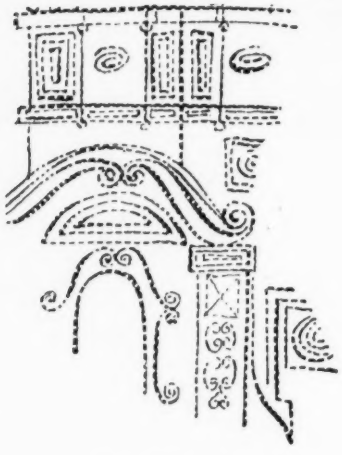

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A 50 c.p.s. A.C. is superimposed on a polarographic electrode system. During each cycle the polarizable electrode is charged from 0 to -2V, and then back again from -2V to 0. The oscilloscope shows dV/dt (vertical) against V (Horizontal). The oscillogram for a pure carrier electrolyte has an oval shape, its upper half is the cathodic branch, the lower the anodic. When a depolariser is present the curve indicates incisions as shown above. Their depth is proportional to concentration. If displaced horizontally it indicates that the electrode reaction is not reversible. The instrument is suitable for analysis in the range 10^{-3} to 5×10^{-5}M. By use of electrolyte concentration (Switch 'MICRO' on the instrument) or by a hanging drop method, 10^{-9} can be reached. A mechanical drop time controller varies the drop time between 1 and 7 seconds. Comparative titrations can be performed by using twin electrode systems, and observing two oscillograms displaced horizontally. Titrant is added until the depth of incisions coincides. Isomers and compounds of similar structure can be very easily examined and identified.

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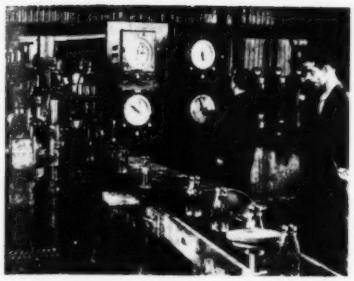
INSTRUMENT APPLICATIONS



Bottles at Forster's Glass Company emerging from feeders whose spout and channel temperatures are kept steady to 0·01% with the aid of Honeywell control system seen in background

Bottle-making Improved by Automatic Control

GLASS level control within ±0·01 in. and feeder temperature control to ±0·1% is being achieved by Forster's Glass Company Ltd., following the introduction of an automatic control system on their furnaces and feeders.

Equipment modernised in this way comprises four regenerative furnaces of their own design and make, and two unit melters by Emhart (U.K.) Limited; also ten batch chargers and twenty feeders.

Radioactive Detectors

The close glass level control within 0·01 in., applied to the molten glass in the forehearth, is achieved with the aid of electronic circular scale controllers by Honeywell Controls Ltd., using radioactive cobalt isotopes for detecting the glass level.

The cobalt unit emits a continuous signal which is amplified by an Isotopes Development Ltd. amplifier and fed to the Honeywell controller. This is a continuous balance instrument of the potentiometer type, which automatically initiates control of a variable speed gearbox on the batch chargers.

Radiation Pyrometers

The ±0·1% temperature control is applied to the channels and spouts of all feeders. The temperatures are controlled by Honeywell circular scale controllers using Radiamatic radiation pyrometers for temperature detection in the channels, and thermocouples for detecting the spout temperatures.

Complete Panels

Control instruments for each furnace are panel mounted and include Honeywell 2-point strip chart recorders for recording reference temperatures in both working end and melting end of the furnace in conjunction with Radiamatic and thermocouple detectors. Fuel flow is controlled by Kent instruments and furnace pressure by Electroflo.

Feeder control instruments are mounted in cabinets disposed on the shop floor to suit machine and feeder layout.

This latest modernisation is part of a long-term plant improvement programme at Forster's to give better quality and very close uniformity to their products.

Circle **45** *for further details.*

Manometers for Testing Coatings

THE upright mercury manometers made by Combustion Instruments from solid blocks of Perspex have found a new application as a result of the increasing use of pressurised telephone cables. These cables are filled with dry air at a pressure of about 8 p.s.i. and it is by measuring this pressure that any leaks in the coating can be detected. Measurements have to be made in the street, at manholes and in subways, so an extremely robust portable instrument is needed. At the same time, movements of as little as 1 mm of mercury column may be significant, so a high standard of accuracy is called for.

The Combustion Instruments manometer fulfils this requirement completely, for it can usually be dropped on the floor without being damaged or even spilling any liquid. Being machined out of the solid, a high standard of accuracy is achieved. Scales are mounted in the same plane as the gauge column to prevent parallax errors. To achieve the highest accuracy a magnifying cursor, also of Perspex, is used.

Circle **46** *for further details.*

Radiographic Examination of Steel Welds

THE U.K. Atomic Energy Authority has just taken delivery of a mobile 4·3 million volt linear accelerator designed to make X-ray examinations of the pressure vessels of nuclear power stations during construction.

Designed by Mullard Research Laboratories, the machine is the first completely mobile linear accelerator to be built anywhere in the world. It was developed under a contract placed by the Authority with Mullard Equipment Ltd.

The machine will enable the welds in the thick steel walls of the pressure vessel containing the reactor cores to be radiographed on site during the building of a nuclear power station, with the minimum of disturbance to the constructional work.

It will be used for the first time at the station being built for the Central Electricity Generating Board at Trawsfynnydd in Merionethshire.

The accelerator has been engineered into a robust self-contained unit, measuring approximately 8 ft 9 in. long by 4 ft 9 in. wide by 5 ft 0 in. high and weighing 2 tons. It can be rotated about both horizontal and vertical axes for rapid, accurate alignment on to the specimen, and may be mounted on a tower, or suspended from suitable lifting tackle.

For the first time on an equipment of this kind, the entire vacuum and cooling systems have been incorporated in the accelerator unit, thus eliminating the problems of lengthy hose connections.

The control cabin housing the ancillary electrical and control equipment is a transportable weatherproof structure of fibreglass which may be sited up to 250 ft away from the accelerator.

The accelerator produces at 4·3 MeV a radiation intensity of over 600 Röntgens a minute at a distance of 1 metre from the X-ray source. The focal spot size is less than 2 mm in diameter.

The present machine uses many of the standard units employed in the standard 4·3 MeV accelerators which have been made by the company for a number of years for medical, industrial research and radiographic applications.

Future U.K. sales of the equipment will be handled by Research & Control Instruments, who are the company's sole agents for radiographic equipment in Great Britain.

Circle **47** *for further details.*

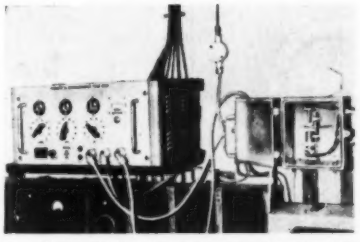
Electronic Counting of Mash Feed at Whitbread's

INSTALLATION of an Electronic Machine Co. electronic batch counter at the Chiswell Street Brewery of Whitbread & Co. Ltd. has been of considerable help in the delivery of malt to the malt hopper.

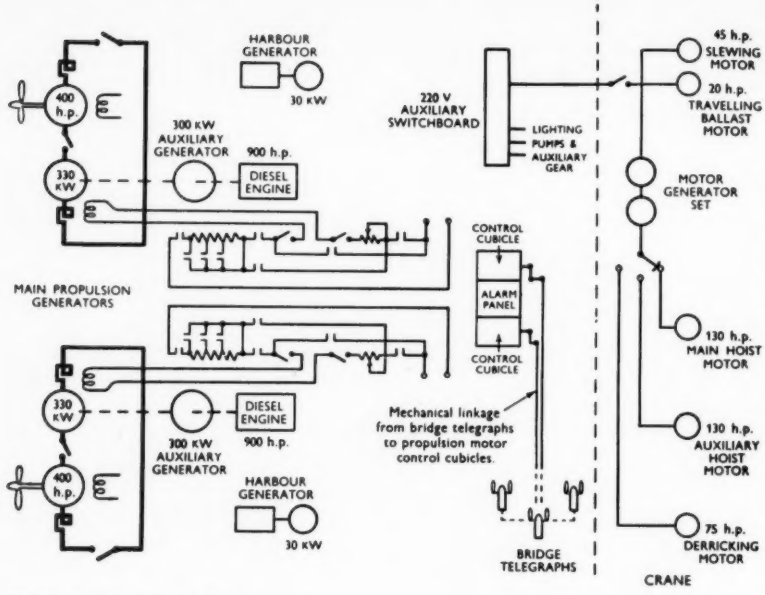
The main shaft of the elevator, which feeds malt to the malt hopper, in turn operates a smaller shaft, which revolves a segmented disc situated in the photocell and light head assembly of the electronic batch counter. As this shaft revolves and each bushel of malt is delivered to the hopper, so the light beam is broken by the segmented disc and causes the count to be registered in the main control unit.

On completion of a "count", which is pre-set according to the particular mix required, the elevator and main malt feed are automatically stopped.

Circle **48** *for further details.*



An electronic batch counter counting bushels of malt at the Chiswell Street Brewery of Whitbread and Co. Ltd. by Electronic Machine Co. Ltd.



Electrical equipment for floating crane

G.E.C. Electrical Equipment on a 60 ton Floating Crane

THE twin-screw floating crane Samson, commissioned earlier this year by the Mersey Docks and Harbour Board, is fitted with main electric power and propulsion equipment manufactured by The General Electric Co. Ltd.

Each of the two 900 h.p. 600 r.p.m., Paxman 12 YLXZ diesel engines is connected through a Twiflex articulated flexible coupling to a main and an auxiliary generator. The rating of each main d.c. generator is 330 kW at 440 V and of each auxiliary d.c. generator 300 kW at 220 V. Power for the propulsion motors is obtained from the main generators, and for all other services from the auxiliary machines. The rating of the auxiliary generators is such that one machine is capable of supplying the entire crane and auxiliary service loads. A further two 30 kW, 220 V, d.c. generators, each driven by a Ruston 6YCZ diesel engine, provide power for the essential services when the 360 kW auxiliary generators are not running. Paralleling of all the 220 V generators is possible, thus preventing interruption of these services when changing the source of supply.

Propulsion Motors

The screws are direct-coupled to 400 h.p. motors which are mechanically and electrically independent, separate Ward-Leonard speed-control systems being employed for each motor. Four steps of speed in either direction are provided for each motor by variation of the appropriate generator field excitation. Relays automatically reduce this excitation if attempts are made to increase the load on the propulsion motors too rapidly. If conditions are such as to cause a sustained overload, then relays operate to remove the excitation completely.

Control of motor speed is normally exercised from the bridge where there are three double telegraphs mechanically-linked through clutches to the operating shafts of the control cubicles. Nevertheless, the propulsion motors can be operated from the engine room by hand-wheels mounted on the control panels.

An alarm indication panel located between the motor control cubicles is arranged to give warning should a fault occur on selected parts of the propulsion equipment. In such circumstances the appropriate green light is extinguished, and a red stencilled panel indicating the type and position of the fault is illuminated. An audible alarm is also sounded which can be silenced by pressing a switch, but the red light will not be cancelled until the fault has been rectified.

Hoisting and Derrick Motors

Power for the 130 h.p. crane hoists and the 75 h.p. derrick motor is obtained from a 107 kW Ward-Leonard set, which in turn is supplied from the 220 V auxiliary generator system. A 3-position rotary-type selector switch enables a choice of either of the hoists or the derrick motor to be made, the speed of the particular motor selected being controlled by a 9-notch controller of the lever type. Speed control is effected by varying the separately-excited and self-excited fields of the Ward-Leonard generator, with the additional facility, in the case of the crane hoist motors, of field weakening on notch 9. The circuit is so arranged that in the event of an overload, or the tripping of a limit switch, the controller has to be returned to the first notch before the particular motor can be re-energised. When loads are being lowered, regenerative braking is employed, and if the auxiliary system is incapable of absorbing the regenerated power, ballast resistors are automatically introduced into the circuit to assist.

Slewing and Ballast Motors

Series-wound slewing and ballast motors are employed, and these are supplied direct from the auxiliary generator system. The 45 h.p. slewing motor is energised through a 6-notch controller and a contactor starter. This starter is fitted with a timing device to prevent the motor being accelerated too rapidly by the operator who nevertheless retains full control over the final speed of slewing. A diverter resistor on the first two notches permits creep-speed slewing.

Speed and direction of the 20 h.p. travelling-ballast motor are varied by a 7-notch controller, and a position indicator working on the potentiometer principle shows the location of the ballast trucks. Warning lights indicate if the forward or backward limit switches trip. Creep-speed operation is obtained by shunting the motor armature with diverter resistors.

Control Cabin

All controls for the operator are housed in a cabin at the front of the crane superstructure. Two consoles, one on either side of the operator's seat, contain warning lights, push-buttons, ammeters and other indicating instruments. One of the consoles also carries the slewing-motor controller and the other the travelling-ballast controller. Immediately in front of the operator is a cabinet, the top of which carries the 3-position rotary switch for selecting either of the hoists or the derrick motor. A lamp in one of the consoles indicates the motor chosen. Adjacent to this switch is the lever-type 9-notch controller for speed variation of the selected motor. Interlocks are fitted to ensure that the selector switch can only be operated when the controller is in the "off" position. Push-buttons are also provided to enable the operator to override the top limit switches of either of the hoists or the derrick motor, and red warning lamps show when this has been done.

Circle **49** *for further details.*

Photoelectronics Automates Gin Packaging

JAMES BURROUGH LTD., distillers of Beefeater gin, have recently had installed photo-electronic controls, developed by Photoelectronics (M.O.M.) Ltd., in their packing lines to provide a fully automatic supply of cartons as and when required.

The installation consists of two light beams passing across the conveyor which are broken by the cartons as they move to the packing department. The problem was to ensure a minimum of five cartons at all times waiting to be filled on a gravity conveyor and to operate the feed conveyor to provide a pre-selected number of cartons to the gravity conveyor on each operation. The light beams are positioned as follows: the first one at a point along the gravity conveyor at a distance of five carton widths from the packing station, and the second beam at a

distance of 25 carton widths from the packing station. The photocells receiving the light beams are connected to a control unit containing the power supplies, memory circuits and time delays, and connections are also made from the control unit to the feed conveyor drive mechanism.

As the cartons are fed along the conveyors the interruption of the light beams through this normal flow is ignored due to the time delays, but as soon as the second beam is permanently broken due to a pile up of cartons then the feed conveyor is stopped. The cartons are then fed by the gravity conveyor to the packing station until the first beam is permanently made due to absence of cartons at this point (i.e., the pile up of cartons is less than 5) and this then automatically starts up the feed conveyor again bringing in a fresh supply of cartons until the second beam is permanently broken which brings the feed conveyor to rest.

This conveyor control system type of installation can be fully installed at a price of less than £100 and is said to save its initial cost during the first few months of operation.

Circle **50** *for further details.*

Dowty Hermic Switches on the Comet

THE Dowty Hermic switches on the Comet are mainly associated with the nose and main undercarriage circuits, also with the flap system, and pressurised doors. Briefly, the undercarriage and flap-operated Hermic switches are used to provide electrical circuit signals during the extension or retraction sequences, while those switches fitted to doors and hatches are to prevent accidental opening while this pressurised aircraft is in flight.

For example, with the undercarriage circuit, the pilot is given a visual warning as to the position of each door. This is done by amber cockpit lights connected to the door-operated Dowty Hermic switches. With the main undercarriage doors, the lamps are only lit when the undercarriages are "travelling", that is being extended or retracted, while with the nose door, the lamp will remain lit at all times when the undercarriage is in any but the locked-up position.

Another example of the use of Dowty Hermic switches on the Comet is in the lever lock system which ensures that the undercarriage cannot be accidentally retracted when the aircraft is on the ground. Basically the system is evolved around a locking pin which, in the undercarriage locked-down position, is inserted into the mechanism to prevent any accidental retraction movement. This pin can only be withdrawn by an electrically-operated solenoid that is in turn controlled by an undercarriage-actuated Dowty Hermic switch.

The Dowty Hermic switch is hermetically sealed, not only against all known climatic conditions, but is also flame- and water-proof. It has double-pole switch contacts with a simple make-and-break snap action, and the Mk 3 can operate at altitudes up to 60,000 ft in temperatures from −40 to 70°C. The switch may be mounted at any angle and is simply secured to the aircraft structure by two 2 BA bolts. It weighs 7 oz.

Hermetic sealing is achieved by the use of special glass/metal seals for protecting the terminal wires, while the switch operating movements are accommodated through metal bellows. The button mechanism, which provides ¼ in. over-travel, is shrouded by synthetic rubber. In the switch itself, the six 6 BA terminals are housed in a mica-filled phenolic-resin block and are protected by a synthetic rubber grommet.

Switch action, shown schematically on the outer case, takes the form of a heavy-duty, double-pole, change-over contact arrangement. The moving contact blades are carried by a rocker and a soft iron armature, which moves between two permanent magnets, to provide the snap action. A unique feature of the design is that contact pressure increases up to the movement of change over, thus reducing the tendency to arcing normally associated with low contact pressures at this point.

Circle **51** *for further details.*

Fuel Oil Flow Control for Open Hearth Furnace

BAILEY METERS AND CONTROLS LTD. have installed a fuel oil flow instrument at the steel works of Messrs. Taylor Bros. Ltd., of Manchester.

The oil is pumped from a main storage tank, through a header at a pressure of 180 p.s.i. at 200°F. A return flow system is used to maintain a constant circulation throughout the system.

The rate of oil flow to each furnace is determined by the operator, who adjusts the set point of the computing relay by means of the set point adjuster. This relay operates as a controller and ensures that the diaphragm-operated control valve maintains the desired fuel supply. The diaphragm control valve is fitted with a positioner, which can characterise the control valve to the air signal by means of the characterising cams supplied with each positioner.

The furnace is fired alternately from one end and then the other. An arrangement was devised which will enable reversing to be carried out whilst fuel oil flow is automatically controlled. This arrangement is shown in the diagram. When the reversing valve is in the normally open position, the air valve, which is operated by the action of the reversing valve, is shut. This allows the system to operate under the normal control of the fuel oil flow loop.

When the reversing valve is shut, the air valve is open, which then bleeds air to atmosphere. The pressure in chamber "A" of the stacked relay goes to zero, thereby shutting off the air supply to the control system and closing the fuel oil control valve.

When the next cycle begins, the reversing valve opens, and the air valve closes. This then allows air pressure to build up at a rate predetermined by adjusting the throttle. As this pressure increases, the pressure in chamber "A" of the stacked relay is increased, thereby transmitting a steadily increasing set point signal to the computing relay which slowly opens the diaphragm control valve, and avoids furnace "Puffs" which can occur when firing is commenced too suddenly after a reversal.

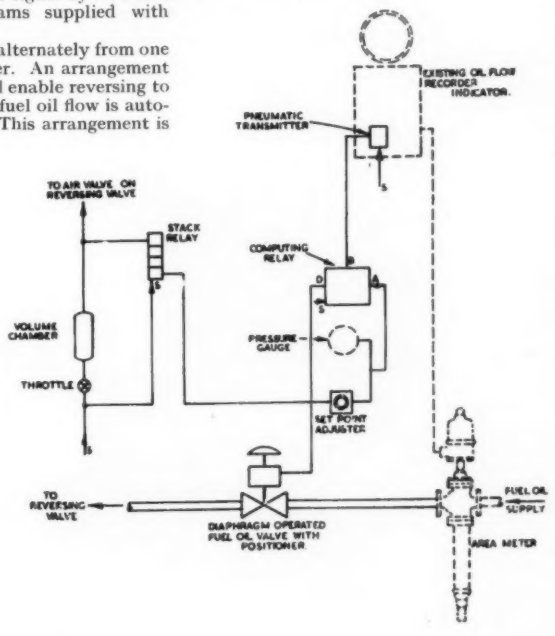
It is also possible to install a control loop to control the steam flow to the atomising burners, operating in conjunction with the fuel oil control, described above.

Circle **52** *for further details.*

Recording Silica Concentration

PREVENTION of dangerous silica concentrations in the effluent water of demineraliser systems is assured with an "early warning" chemical analysis system called the Technicon AutoAnalyzer (manufactured by Technicon Instruments Co. Ltd.). This automatic system provides a continuous recording of silica concentration down to one part per billion.

Complete automation of demineraliser plants is now made possible with the new on-stream system.



Scheme for oil flow control installed at steel works in Manchester

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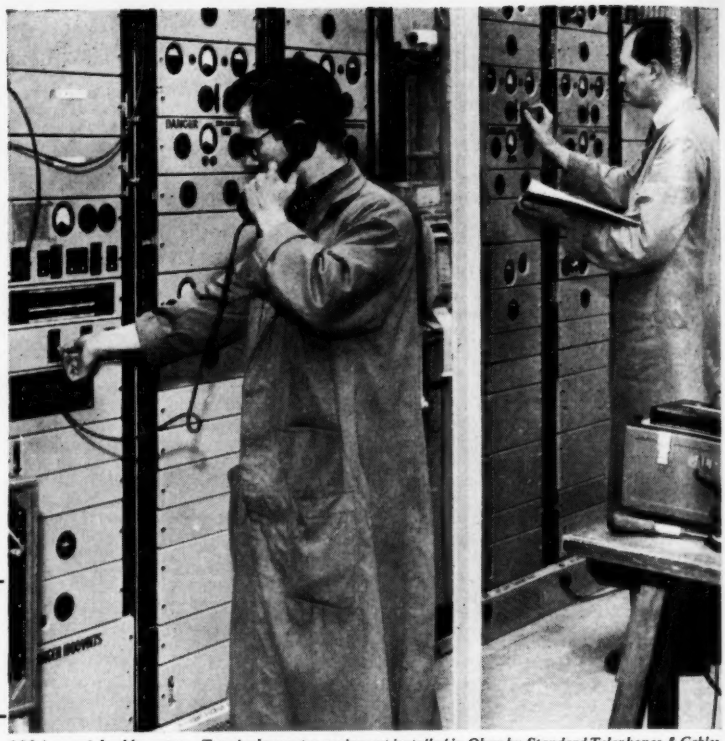

4 Mc/s coaxial cable system. Terminal repeater equipment installed in Oban by Standard Telephones & Cables Ltd — part of the transatlantic telephone link.

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Not only does the AutoAnalyzer monitor the demineraliser effluent, but it can automatically signal an alarm, switch the system from one resin bed to another, and activate automatic regeneration of the depleted bed.

In the case of a silica breakthrough that occurred during routine operation of a demineraliser train in a power station, the Technicon AutoAnalyzer accurately provided the complete breakthrough picture. The AutoAnalyzer can also provide continuous records of trace quantities of copper, iron, phosphate, hardness, chloride and other materials present in the steam-water cycle.

Basically, the AutoAnalyzer's pump unit proportions the samples and reagents in a continuously flowing stream. The characteristic blue colour indicating silica concentration is developed in the stream. Colour intensity is measured in a flow-type colorimeter, and its value is plotted continuously on a strip chart recorder.

The precision proportioning pump can handle as many as eight reagents simultaneously. Peristaltic pumping action is performed by compressing plastic tubes with rollers against a platen. Pumping rates are governed by the tube size. Tubes are available in different sizes with inside diameters from 0·030 in. to 0·110 in., giving varying delivery rates of from 0·32 ml to 3·50 ml per minute.

Circle **53** *for further details.*

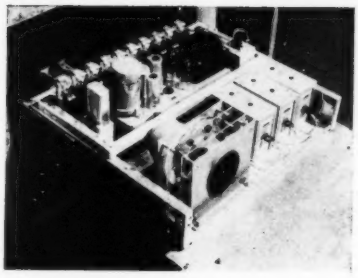
Noise Level Recorders for Efficiency Control in Ball Mills

NOISE level recorders are now being used in an entirely new approach to the problem of controlling efficiency in ball mills. This new method has recently been applied in a cement mill in Uganda, where noise level recorders supplied by the Electrical Measurement Division of Elliott Brothers (London) Ltd. have been installed and are reported to be working entirely satisfactorily.

The noise level within the mill not only gives information on the loading of the mill but also a direct indication of the size of the particles of the product as grinding proceeds. The traditional method of measurement by wattmeter gives only the load.

Noise level recording enables the operator to determine the most efficient loading of the mill and the device can be used to give alarm and control signals for deviations from desired values. Under normal operating conditions maximum noise is obtained at the beginning of each batch, with a gradual decrease to the minimum level at the end of the run, or, in the case of continuously operated mill, the level is more or less constant. As the arrangement measures the total noise level at any pre-determined plant location, any increase from the pre-set level can be indicative of normal plant operation, plus extraneous noises. These extraneous noises are normally taken into account when determining the desired value set point. Therefore, any abnormal rise in the level constitutes an alarm condition. In the Uganda project this characteristic is used to keep a continuous check on the mill bearings, in addition to the normal efficiency/quality control.

Circle **54** *for further details.*



System programmer for an automatic scanner being sent to Kuwait by Honeywell Controls Ltd.

Automatic Alarm Scanning

AUTOMATIC alarm scanning will be carried out on 100 pre-set temperature points at the Kuwait Oil Company Ltd. refinery, Kuwait, by means of a 1-point-per-second unit newly completed by Honeywell Controls Ltd. for the main contractors, Harton and Co. Ltd.

Temperature points are indicated by neon lamps in 5 groups of 20, each lamp having an associated toggle switch for manual verification using a common vertical precision indicator mounted below.

To the left of the indicator the main control panel contains start and stop push-buttons, auto/manual changeover, manual step push-button, lamp test and calibration switch. Nixie lights identify the point being scanned.

The lowermost section houses the power supply unit and the system programmer drawer, which can be modified to provide 2-points-a-second scanning by substituting a different sequencing motor.

Special Features

Neon tubes are used to provide the alarm memory, a function hitherto generally performed by relays. Each lamp assembly comprises a trigger tube and an indicator. If an alarm occurs, the individual indicator will remain illuminated and a klaxon will sound; during subsequent scanning, however, the indicator only will remain and the audible alarm will not be repeated.

If any temperature point is being manually checked on the precision indicator, this point is automatically by-passed during the scanning.

A further detail of interest is that alarm points are set in terms of temperature. Each of the 5 groups has a potentiometer for determining the alarm point in conjunction with the calibrating switch and the precision indicator.

Circle **55** *for further details.*

Measurement of Ultra-low Pressures

WESTINGHOUSE RESEARCH LABORATORIES have developed a method for measuring pressures less than 10^{-12} atmospheric pressure at the earth's surface.

The device, known as a photomultiplier ion gauge, was developed by Westinghouse as part of an ultra-high vacuum research programme supported by the U.S. Atomic Energy Commission's Project Sherwood. Project Sherwood is a long-range research programme aimed towards achieving controlled nuclear fusion for peacetime uses.

Instruments which measure extremely low pressures do so by placing electrical charges upon the gas particles remaining in a vacuum system and counting the rate at which these charged particles or ions form. Conventionally, these charges come from electrons that are boiled off the surface of a hot tungsten filament—similar to the filament in an ordinary light bulb—that is located inside the vacuum system and in contact with the gas being measured. In many instances the gas interacts with the hot filament surface, breaking the gas down and converting it to an entirely different substance. Thus the very act of measuring the gas pressure contaminates the gas and upsets the entire experiment.

The new pressure-measuring device does away with the heated filament completely. Instead of using a hot surface to produce the required ionisation of the gas, a beam of ultra-violet light is used. The light is beamed on to a metal surface which has the ability to release electrons under the stimulus of the ultra-violet rays. These electrons are guided on to a series of similar surfaces which multiply the electrons in speed and number. These electrons then are used to form the ions that are collected and counted in the usual fashion.

The photomultiplier ion gauge will be useful in a variety of key ultra-high vacuum research experiments, being ideally suited to low-pressure studies of hot filament-gas interactions such as those encountered in the ordinary fluorescent lamp, in electronic tubes and in thermionic energy converters.

The gauge is linear with pressure over the range from 10^{-9} to 10^{-10} millimetre of mercury. This range of pressures is equal to that encountered in space at distances between 50 and 650 miles above the surface of the earth.

British Standard for Extra Precision Bearings (P.D.3964 : 1960—Addendum No. 1 to B.S. 292 : 1958)

THE tolerances on dimensions and running accuracies for extra precision bearings given in this addendum to B.S.292 apply only to bearings with metric dimensions.

The tolerances, which are given in inch and metric units, refer to rigid single-row ball journal bearings, angular contact single-row ball bearings and rigid parallel-roller journal bearings.

In due course, a separate British Standard will be issued, relating to instrument bearings, which require special dimensions and characteristics.

Copies of this standard may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1, price 3s. 0d. (Postage will be charged extra to non-subscribers.)

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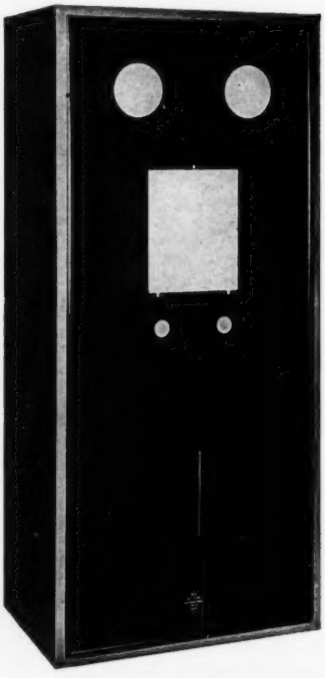

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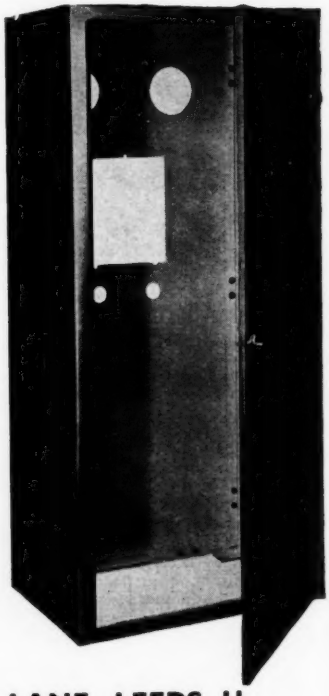

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Mr. T. E. Greenfield

Mr. E. B. Thompson

Mr. D. Riddell

PERSONALITIES

Mr. A. A. Young

Three new directors have been appointed to the board of Westool Ltd. They are **Mr. D. Riddell,** chief engineer, **Mr. D. L. Shand,** works manager, and **Mr. A. G. Why,** secretary and accountant.

Mr. Riddell joined the company as research engineer in 1946 and was appointed to his present position in 1954.

Mr. Shand was appointed works manager in 1958 and Mr. Why first joined the company in January, 1959.

Mr. G. R. Hook has resigned from the board after 41 years with the company, during which he was for many years managing director.

Belling & Lee Limited announce the appointment of **Mr. B. M. Lee** as manager of their industrial group, reporting to the company's general manager, and to the board of executive directors. This is a further step in the divisionalisation of the company into separate industrial and domestic groups, in a programme of controlled expansion which began with the reorganisation of the sales department earlier in the year. He will be responsible for co-ordinating the production, publicity and sales of the industrial group.

British Insulated Callender's Cables Limited announce the appointment of **Mr. W. E. Hind** as manager (Home Sales). His new responsibilities cover all aspects of the selling activities of the company at home and include matters of publicity, public relations, exhibitions and display, and market research.

Mr. Hind was formerly deputy manager (Home Sales).

Air Vice-Marshal W. E. Oulton, C.B., C.B.E., D.S.O., D.F.C., retired from the Royal Air Force after 32 years' service to join the board of E.M.I. Electronics Ltd. on 1st January as director responsible for Ministry work.

During his service career, Air Vice-Marshal Oulton has acquired an international reputation as an expert on navigation, air traffic control, anti-submarine warfare and nuclear weapon testing.

Mr. T. E. Greenfield has been appointed sales development manager of the Industrial Process Control Division of Gresham Automation Ltd.

Mr. E. W. Dixon has recently been appointed assistant works manager at the Greenock, Scotland, factory of IBM United Kingdom Ltd.

Mr. Dixon, a native of London, joined IBM at Greenock in February, 1959, as a production executive, having had a wide experience in various industrial concerns in many parts of England.

Evershed & Vignoles Ltd.'s District Office at 14 Yarm Lane, Stockton-on-Tees (Telephone Stockton 64288) is now under the supervision of **Mr. D. Watson.** The area covered from this office includes Northumberland, Durham, and the Cleveland District of Yorkshire.

In order to cope with expanding business, Wild-Barfield Electric Furnaces Ltd., of Watford, Herts., have carried out some internal reorganisation and made some new appointments, all of which have been filled from within the company.

Executive manager (Engineering)—**Mr. W. R. Brew;** executive manager (Commercial)—**Mr. F. L. Gladwin;** executive manager (Production)—**Mr. O. V. Metcalfe;** sales manager—**Mr. R. C. Ray.**

Mr. M. Rowledge, export sales manager of Parkinson Cowan Ltd., started on a 20,000 mile Caribbean tour on 21st November, 1960.

Main purposes of the tour are to promote the sales of Parkinson Cowan appliances in areas where liquid petroleum gas and natural gas are used, to appoint new Parkinson Cowan agents and to discuss with overseas water engineers the present and future of liquid metering.

Since joining Parkinson Cowan International Ltd. five years ago, Mr. Rowledge has already completed three other major tours in the Middle East, North Africa and Europe.

Mr. E. B. Thompson, sales manager, Ekco Electronics Ltd., has been elected chairman of the Nucleonics Group of the Scientific Instrument Manufacturers' Association.

The Electronics Section, which previously embraced the Nucleonics Group, is under the chairmanship of Major Wm. Logan, of Avo Ltd.

Mr. Alan A. Young, of Grangemouth, has recently been appointed sales engineer for Scotland and Northern Ireland by B. & R. Relays Limited.

Mr. Young was previously employed as an electrical engineer at the B.P. Refinery at Grangemouth and is experienced in the maintenance of electrical equipment involving relays and control circuits.

Dewrance & Co. Ltd. advise that **Mr. J. W. Storey, C.B.E.,** has resigned his position as managing director in order to devote more time to his personal interests, particularly in the domestic boiler field.

Mullard Ltd. announce that **Mr. E. W. Embleton** has been appointed manager of its industrial sales force which serves the commercial divisions of the company dealing with magnetic components, semiconductor devices and industrial valves and tubes.

Mr. Embleton has been in the radio and electronics industry for over 18 years and has for some time been engaged in sales activities in the company's Semiconductor Division.

Before joining Mullard in 1953, he was with the Admiralty Signals and Research Establishment.

Mr. J. B. Spence has been appointed to the board of Lancashire Dynamo & Crypto, a member of the Metal Industries Group, and will be general manager of the company's works at Willesden, N.W.

Mr. Spence, who was previously acting general manager at Willesden, succeeds the late Mr. C. F. Jackson.

Dr. W. E. Rowlands has joined Walmore Electronics Ltd. as sales manager. He was previously assistant sales manager of the General Electric Company subsidiary, M.O. Valve Co. Ltd.

Walmore Electronics Ltd. are the United Kingdom representatives for the Eimac range of electronic valves, and specialise in supplying "professional" valves, semiconductors and components to the electronic industry.

Mr. A. J. Cornwall, technical services manager of Aveley Electric Ltd., is now the company's chief inspector for D.G.I. approval.

Mr. Cornwall has been with the company since its inception and is very familiar with all instruments and components handled and manufactured by Aveley Electric Ltd.

Photoelectronics (M.O.M.) Ltd. announce the appointment of **Mr. Robert Carter-Pedler, B.A.,** as sales manager of the company.

In his new capacity Mr. Carter-Pedler will be able to continue to offer a complete range of photo-electric and electronic controls together with a design and development service for new projects.

Mr. Arnold Lindley, who was an apprentice when he began his career with the company, was elected to the chairmanship of G.E.C. in November, 1960. He succeeded Sir Leslie Gamage, M.C., on 1st January, 1961.

Mr. Alan M. H. Davies, O.B.E., M.A.,F.I.W.M.,has been elected chairman of the Institution of Works Managers, 196 Shaftesbury Avenue, London, W.C.2, for the Institution's thirtieth year—1960-61. Elected a member of the Institution in 1933 and honoured with a Fellowship in 1945 in recognition of his outstanding contribution to industry, Mr. Davies has served for many years on the council and as chairman of the Education Committee of the Council.

Mr. D. H. Atkinson has been appointed personnel manager for the Ilford region of the Plessey Co. Ltd.

Before joining Plessey Mr. Atkinson was a personnel manager with Rolls-Royce Ltd.

Col. C. E. Mackellar, director of Westool Ltd., St. Helen's Auckland, Co. Durham, and **Mr. J. B. Bailey,** chief applications engineer of the company, have been visiting Russia to discuss modern techniques in coil winding, and the application of various control equipment to Russian industry. They also explored the possibilities for the export to Russia of coil winding machines, electric clutches and brakes and air conditioning equipment.

Dr. Hanns L. Mennicken has been appointed executive in charge of the new West Instrument sales and service organisation in Germany and will be responsible for the whole of the company's activities in that country. West Instrument, which is associated with West Instrument Corporation in the U.S.A., is in fact supplying its "Gardsman" temperature control instruments to a number of leading German manufacturers.

Mr. R. H. Carter has been appointed general manager of Tomey Industries in succession to Mr. S. W. Cadden, whose service agreement as managing director has expired.

FORTHCOMING EVENTS

February 17th. **Society of Non-destructive Examination.** Caxton Hall, Westminster, at 6-15 p.m. "The Evolution of Non-destructive Testing." Dr. L. Mullins.

February 18th. **Society of Instrument Technology.** Manchester Section. Nag's Head, Jackson's Row, Manchester, at 6-45 p.m. Visit to British Railways Signal Box.

February 22nd. **Society of Instrument Technology.** Tees-side Section. Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, at 7-30 p.m. "New Steelmaking Processes and their Control Problems." Dr. P. A. Young.

February 22nd. **Society of Instrument Technology.** South Wales Section. Newport and Monmouthshire College of Technology, Newport, at 6-45 p.m. "The Manufacture, Properties and General Uses of Metal Bellows." R. W. Houghton.

February 23rd. **Society of Instrument Technology.** Chester Section. Lecture Theatre, Administration Building, The Associated Ethyl Co. Ltd., Oil Sites Road, Ellesmere Port, Wirral, at 7-0 p.m. "The Atomic Clock." J. V. L. Parry.

February 24th. **Society of Instrument Technology.** Scottish Section. Building Centre, Sauchiehall Street, Glasgow, at 7-15 p.m. "Interesting the Instrument Mechanic in Fundamental Principles." F. Rout.

February 28th. **Society of Instrument Technology.** London Branch. Manson House, 26 Portland Place, London, W.1, at 7-0 p.m. "Three Terminal Bridge Measurements and Automation." Dr. V. S. Griffiths.

March 1st. **Society of Instrument Technology.** South Yorkshire Section. Metropole Hotel, Leeds, at 7-0 p.m. "High Speed Instruments for Combustion Research." A. E. Pengelly.

March 3rd. **Society of Instrument Technology.** Fawley Section. Administration Building, Esso Refinery, Fawley, at 5-30 p.m. Visit. Details to be promulgated locally.

March 9th. **Society of Instrument Technology.** Liverpool Section. M.A.N.W.E.B. Industrial Development Centre, Liverpool, at 7-0 p.m. "Design, Application and Selection of Automatic Control Valves." P. Stone.

March 10th. **Society of Instrument Technology.** Midland Section. Lecture Theatre of the Byng Kendrick Suite at the Gosta Green College of Technology, Aston Street, Birmingham, at 7-0 p.m. "Control Problems of Nuclear Power Stations." R. B. Quarmby.

March 13th. **Society of Instrument Technology.** Bristol Section. University of Bristol, Department of Physics, The Royal Fort, Bristol, 8. at 7-30 p.m. "The Industrial Use of Precision Scales." P. A. McKeown.

March 14th. **Society of Instrument Technology.** Manchester Section. Nag's Head, Jackson's Row, Manchester, at 6-45 p.m. "Brains Trust"—on Maintenance.

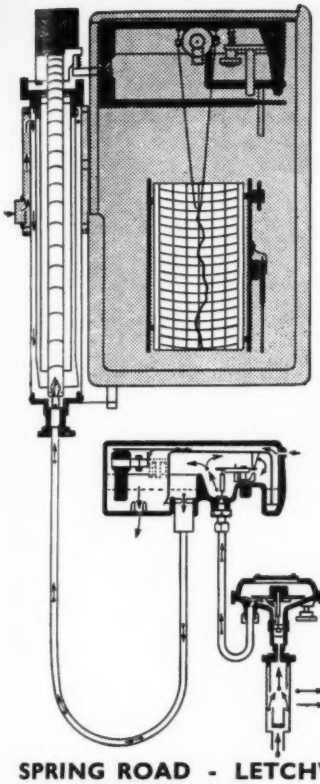
March 15th. **Society of Instrument Technology.** Data Processing Section. Manson House, 26 Portland Place, London, W.1. Symposium on Burst Slug Detection in Nuclear Power Stations.

March 16th. **Society of Instrument Technology.** East Midland Section. Derby & District College of Technology, Kedleston Road, Derby, at 7-15 p.m. "Recent Developments in Industrial Electronics." E. Metcalf.

March 16th. **Society of Instrument Technology.** Grangemouth Section. Leapark Hotel, at 7-0 p.m. Annual General Meeting followed by a Film Show on "Transistors".

March 16th. **Society of Instrument Technology.** Newcastle Section. The Conference Room, Roadway House, Oxford Street, Newcastle-upon-Tyne, 1, at 7-0 p.m. "The Rotameter Sheds its Limitations." H. Williamson.

March 22nd. **Society of Instrument Technology.** Tees-side Section. Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, at 7-30 p.m. Annual General Meeting followed by "Some Impressions of Instrumentation in the U.S.S.R." E. N. Martin.



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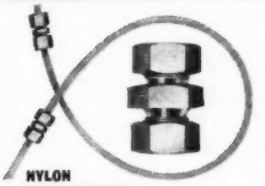

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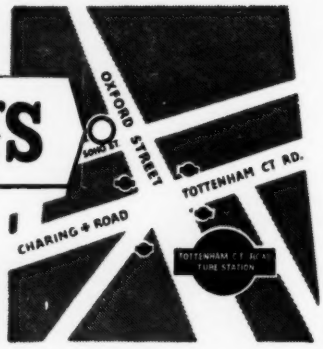

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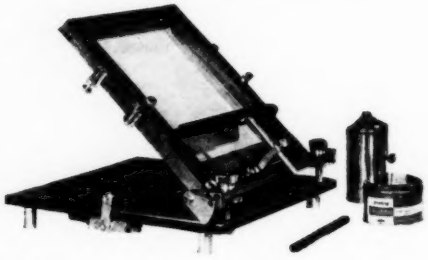

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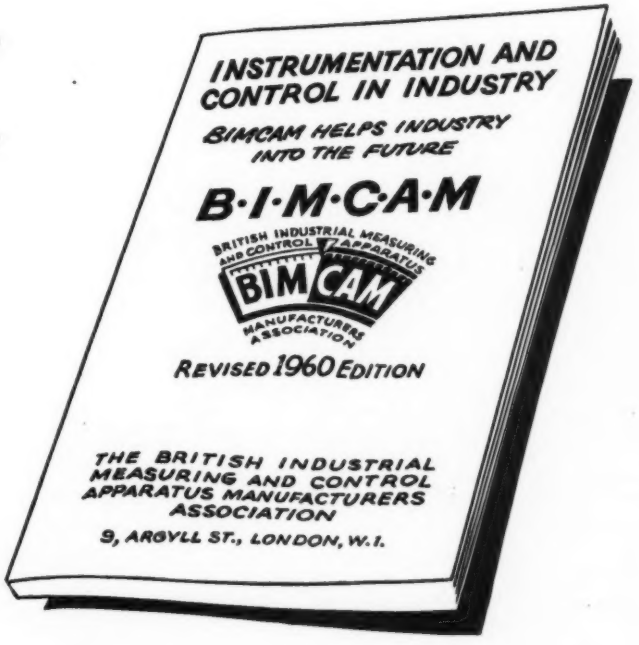
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MINISTRY OF AVIATION require an Engineer III in Air Technical Publications Branch, Chessington, Surrey, to prepare and/or supervise contractors' preparation of, technical publications for Services on theoretical and practical aspects of special weapon and navigational systems and associated test equipment. Qualifications: Recognised engineering apprenticeship or equivalent training, and corporate membership of Institution of Mechanical, Electrical or Civil Engineers or have exempting qualifications. Experience of electrical and instrument fields, and knowledge of application of electronics in control and monitoring systems. Experience in writing and/or editing of technical matter desirable. Salary: £830 (age 25) to £1,300 p.a. (London scale). Commencing salary £1,125 p.a. at age 34 or over. Not established, but opportunities to compete for establishment may arise. Forms from Ministry of Labour, Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting D.12/1A. Closing date 28th February, 1961.

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3. Application forms available from the High Commissioner of India, Establishment Department, India House, London, W.C.2, quoting 15/33, to whom completed applications should be sent before the 21st February, 1961.

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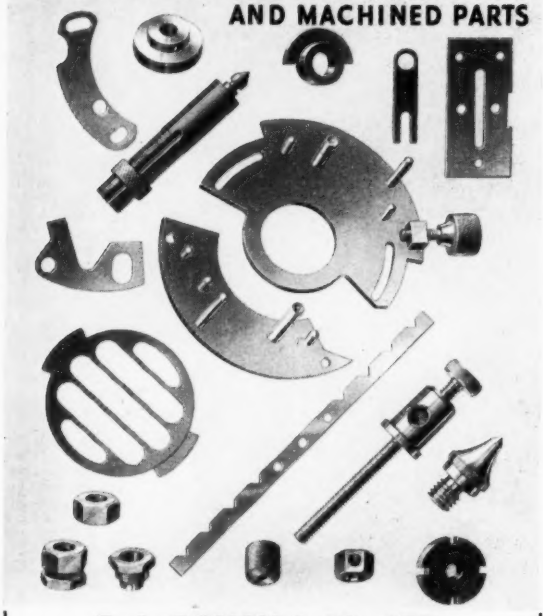

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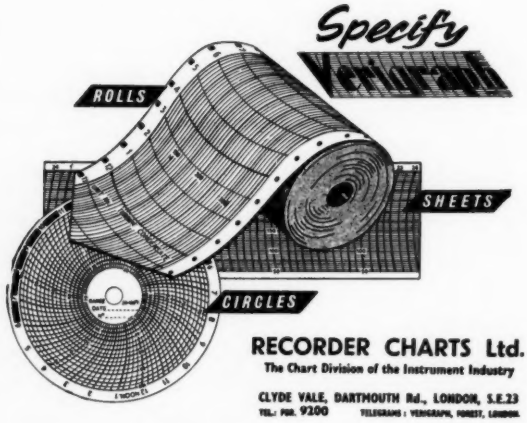

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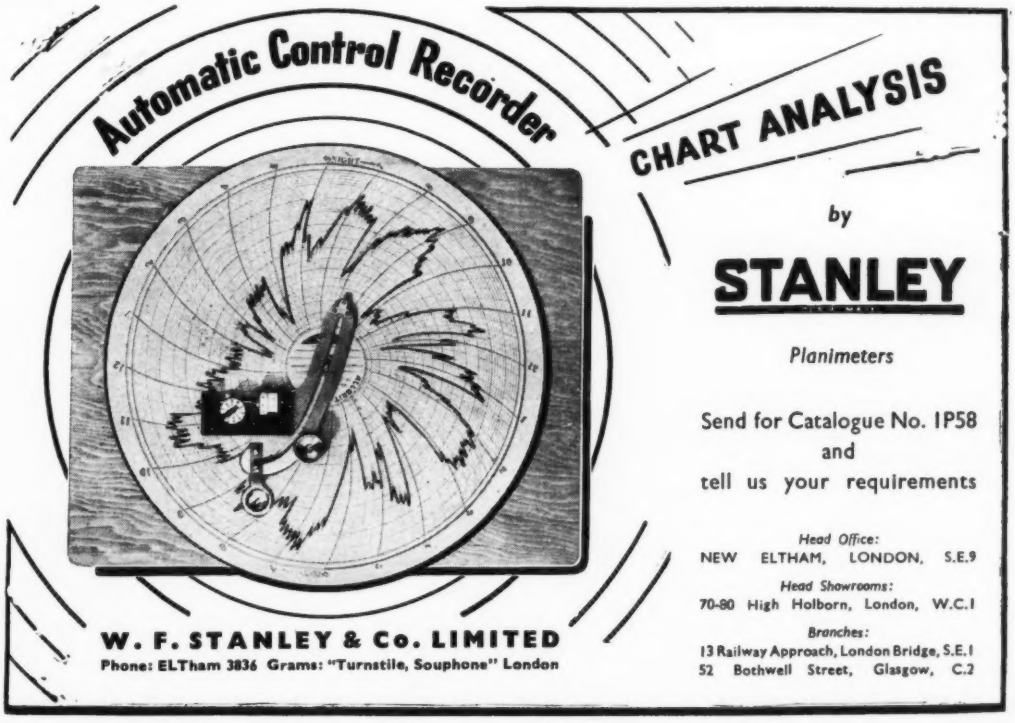

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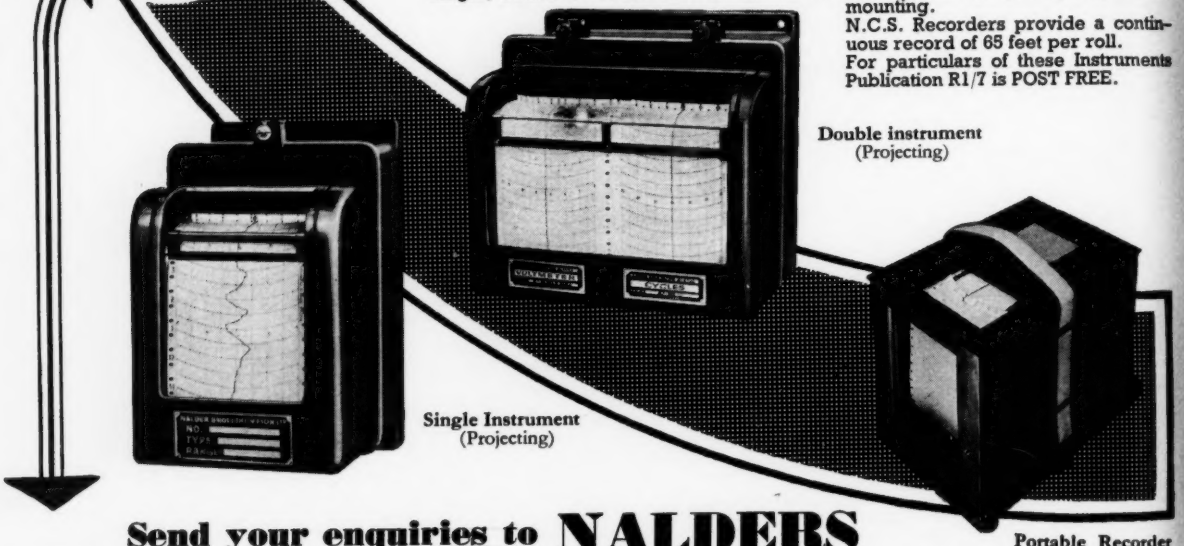

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Published by the Proprietors, United Trade Press Ltd., 9 Gough Square, Fleet Street, London, E.C.4, and printed by Herald Printing Works, York and London. Registered for transmission by Magazine Post to Canada. Annual subscription rate 50/- to be sent direct to United Trade Press Ltd., 9 Gough Square, Fleet Street, London, E.C.4, England.